Service Manual

Verification Draft

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M4735A Defibrillator/Monitor

Agilent Technologies

Notice

About This Edition

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The information in this manual applies to the M4735A Heartstream XL Release A.0.0. This information is subject to change without notice.

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WARNING

Radio Frequency (RF) interference from nearby transmitting devices may seriously degrade performance of the M4735A. Electromagnetic compatibility with surrounding devices should be assessed prior to using the defibrillator.

CAUTION

Use of supplies or accessories other than those recommended by Agilent Technologies may compromise product performance.

THIS PRODUCT IS NOT INTENDED FOR HOME USE.

IN THE U.S., FEDERAL LAW RESTRICTS THIS DEVICE TO SALE ON OR BY THE ORDER OF A PHYSICIAN.

Medical Device Directive

The M4735A Defibrillator/Monitor complies with the requirements of the Medical Device Directive 93/42/EEC and carries the CE 0123 mark accordingly.

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Conventions

This manual uses the following text conventions:

Printed and On-Line

NOTE	Notes contain additional information on servicing this product.
CAUTION	Caution statements describe conditions or actions that can result in damage to the equipment or loss of data.
WARNING	**Warning statements describe conditions or actions that can result in personal injury or loss of life.**

Text	represents messages that appear on the display
Softkey	represents softkey labels that appear on the display above or below the button to which they correspond

On-Line Only

Hypertext	represent hypertext links, which will display as blue; click on the link to go to that destination, then click on the destination to return.

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Contents

Conventions

Printed and On-Line iii
On-Line Only iii
Hypertext iii

Introduction

Overview 1-1
Defibrillator/Monitor 1-1
Batteries 1-2
Installation 1-2
Upgrades 1-2
Preventive Maintenance 1-2
Repair Philosophy 1-3

Performance Verification and Safety Tests

Overview 2-1
Chapter Contents 2-1
Mandatory Testing 2-2
External Repairs/No Trouble Found 2-2
Printer 2-3
Internal Repairs 2-3
Test Matrix 2-4
Test Equipment 2-8
Configuration and Diagnostic Modes 2-10
Configuration Mode 2-10
Diagnostic Mode 2-11
The Software Support Tool 2-12
Using the Support Tool 2-12
Performance Verification 2-14
Visual Inspection 2-15
Functional Checks 2-16
Diagnostic Tests 2-19
Safety Tests 2-39
Battery Capacity Test 2-40

Contents

Troubleshooting

Overview 3-1
Chapter Contents 3-1
Repair Philosophy 3-1
Equipment Required 3-1
Troubleshooting and Repair Methodology 3-2
Methodology Overview 3-2
Initial Assessment 3-3
Diagnosing External Failures 3-4
Diagnosing Internal Failures 3-5
Troubleshooting Tables 3-6
Using the Tables 3-6
General Problems 3-8
Unit Unresponsive 3-8
Error Codes 3-10
System Messages 3-12
Momentary Messages 3-14
Audio Tones 3-16
Extended Self Test Failures 3-17
Operational Problems 3-18
ECG Monitoring 3-18
SpO_2 Monitoring 3-20
Defibrillation and Cardioversion 3-21
Pacing 3-24
Printer 3-25
Display 3-26
Audio 3-27
Keys 3-28
Battery and Charging Circuits 3-29
Data Card 3-30
Calling for Service 3-31
United States of America 3-31
Canada 3-31
Other International Areas 3-31
Equipment Information 3-31

Removal and Replacement

Overview 4-1
Chapter Contents 4-1
Servicing Notes 4-1
Key Components 4-1
Removal, Handling, and Replacement 4-2
Tool Requirements 4-3

Disposal 4-3
External Assemblies 4-4
User-replaceable Parts and Accessories 4-5
User Maintenance 4-5
Printer Assembly 4-6
Battery Cover 4-10
Main Fuse 4-12
Battery Eject Assembly 4-14
Data Card Door 4-16
Energy Select Knob 4-17
Paddle Holders 4-18
Labels 4-20
Label Descriptions 4-20
Removing and Replacing Labels 4-22
Opening the Case 4-24
Discharge the Power Supply Capacitors 4-24
Separate the Case 4-26
Discharge the Defibrillator Capacitor 4-30
Identifying Internal Subassemblies 4-32
Internal Assemblies - Top Case 4-33
Lithium Backup Battery 4-34
Control PCA 4-36
Shield Plate 4-40
Keyscan PCA 4-42
Bezel Assembly 4-48
Energy Select Switch 4-52
..... 4-53
Display Assembly 4-54
Parameter PCA 4-56
SpO2 PCA 4-58
ECG Connector 4-60
SpO2 Connector 4-62
Speaker 4-64
AC Mains Connector 4-66
ECG Out (Sync) Connector 4-69
Pacer Keypad 4-70
Replacement Top Case 4-75
Internal Assemblies - Bottom Case 4-79
Battery PCA 4-80
Defibrillator Capacitor 4-84
Power PCA 4-86
AC Power Module 4-90
Patient Connector 4-94
Replacement Bottom Case 4-97
Closing the Case 4-99

Contents

Replacement Parts

Overview 5-1
Chapter Contents 5-1
Ordering Replacement Parts 5-1
Ordering Supplies and Accessories 5-1
Key Components 5-2
Calling for Service 5-3
United States of America 5-3
Canada 5-3
Other International Areas 5-3
Special Tools 5-4
M4735A Unit Exchange Program 5-5
Replacement Parts Tables 5-6
Electrical Assemblies 5-7
Control PCA 5-7
Other Replacement PCAs 5-8
Other Electrical Assemblies 5-8
Individual Electrical Parts 5-9
Mechanical Assemblies 5-10
Bezel Assembly 5-10
Pacer Keypad Assembly 5-11
Other Mechanical Assemblies 5-12
Connector Assemblies 5-12
Individual Mechanical Parts 5-13
Labels 5-14
Instruction Label Sets 5-14
Case Label Sets 5-16
Other Labels 5-17
Supplies & Accessories 5-18
Key Components 5-21

Theory of Operation

Overview 6-1
PCA Descriptions 6-2
Control PCA 6-2
Power PCA 6-3
Parameter PCA 6-3
Keyscan PCA 6-3
SpO2 PCA 6-4
Battery PCA 6-4
Battery 6-4
AC Power Module 6-4
Printer 6-4

System Level Interconnections 6-5
System Functional Descriptions 6-6
Signal and Data Flow 6-6
ECG Monitoring Functions 6-7
Patient impedance functions 6-7
SpO2 Monitoring Functions 6-8
Defibrillation Functions 6-9
Pacing Functions 6-11
Audio Functions 6-11
Display Functions 6-11
Indicator Functions 6-11
Key Functions 6-11
Energy Select Switch 6-12
Printing Functions 6-12
Battery/Power Functions 6-12
Lithium Backup Battery 6-15
Data Card 6-15

Specifications

Overview 7-1
Specifications 7-1
Defibrillator 7-1
ECG Monitoring 7-3
Display 7-4
Battery 7-4
Thermal Array Printer 7-5
Noninvasive Pacing 7-6
SpO_2/Pulse Oximetry 7-6
Event Storage 7-6
General 7-7
Environmental 7-7
Waveforms - 150J 7-8
Waveforms - 200J 7-11
Symbol Definitions 7-14
Safety Considerations 7-16
Electromagnetic Compatibility 7-19
Reducing Electromagnetic Interference 7-19
Restrictions for Use 7-20
Immunity Level 7-20

Contents

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1 Introduction

This Service Manual provides the information needed to successfully service the Agilent M4735A Heartstream XL Defibrillator/Monitors. The intended users of this manual are technical personnel who have been trained in the safe and proper servicing of the M4735A.

Overview

In this chapter, you'll find general information that you should become familiar with before servicing the M4735A. Detailed information regarding controls, operation, and capabilities of the instrument can be found in the ***User's Guide*** (M4735-91900) that was shipped with the product. We recommend you review the ***User's Guide*** before servicing this device. This Service Manual assumes you are familiar with the controls and with basic operations.

Defibrillator/Monitor

The M4735A is a biphasic, semi-automatic external defibrillator. This portable, lightweight device offers two modes of operation for defibrillation:

- Semi-Automatic External Defibrillation (AED) Mode
- Manual Mode

In AED Mode, the M4735A analyzes the patient's ECG and advises the clinician whether or not to deliver a shock. Defibrillation is performed through multifunction defib electrode pads.

In Manual Mode, the M4735A turns control of the defibrillation process over to the clinician. The clinician analyzes the patient's ECG, decides if defibrillation is advised, and determines the energy setting for defibrillation. Defibrillation is performed either through multifunction defib electrode pads or through paddles.

Manual Mode also allows the clinician to perform synchronized cardioversion and offers optional noninvasive pacing (using a monophasic waveform).

ECG monitoring can be accomplished in either mode using one of 3 methods:

- ECG from the defib pads
- 3-lead ECG using separate monitoring electrodes
- Optional 5-lead ECG using separate monitoring electrodes.

Optional pulse oximetry (SpO_2) monitoring is available in both modes, as well.

The M4735A automatically stores critical events, such as shocks and alarm violations, in its internal memory. An Event Summary may be printed at any time. The M4735A also enables you to store data and events on an M3510A

Data Card for downloading to the CodeRunner Web Data Management System.

Batteries

The M4735A is powered by a rechargeable Sealed Lead Acid (SLA) battery (M3516A). Proper care of these batteries will ensure that they have the energy required to operate the M4735A and deliver the appropriate therapy (See "Battery Maintenance" section in ***User's Guide***).

NOTE

The defibrillator will take longer to charge when powered with AC without a battery installed. To ensure optimal performance, always have a fully charged battery in the defibrillator, even when using AC power.

Installation

The M4735A does not require installation. The ***User's Guide*** describes the setup required before placing the device into service, as well as configuration options.

Upgrades

Upgrades are available to add specific functionality to units in the field. As of the publication of this manual, these upgrades are:

- M4738A Pacing Upgrade (adds pacing).
- M4739A SpO_2 upgrade. (adds SpO_2).

Consult your sales representative or dealer or distributor for the latest details.

Preventive Maintenance

Preventive maintenance and periodic operational checks are intended to be performed by the user. Both topics are covered in the Maintenance chapter of the ***User's Guide***.

Repair Philosophy

Defibrillator/Monitor

The repair philosophy of the M4735A is subassembly replacement. Examples of subassemblies are the printer, the Control Printed Circuit Assembly (PCA), and selected connectors and other items. Repairs that involve replacing components on a PCA are ***not*** supported.

CAUTION

Individual component replacement should *not* be attempted outside of a factory authorized repair facility. Component level repair is extremely difficult due to the extensive use of surface mount technology and the high parts-density on the circuit boards. Unauthorized component replacement can impair performance of the M4735A.

Batteries

The repair philosophy for the SLA battery (M3516A) is unit replacement. These items are not repaired in the field.

For information on ordering replacements, see "Supplies & Accessories" on page 5-18.

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2 Performance Verification and Safety Tests

Overview

This chapter describes the tests and inspections required to verify performance of the M4735A Portable Defibrillator/Monitor.

Chapter Contents

The major sections of this chapter are as follows:

Section	Page
Mandatory Testing	2-2
Test Matrix	2-4
Test Equipment	2-8
Configuration and Diagnostic Modes	2-10
The Software Support Tool	2-12
Performance Verification	2-14

Mandatory Testing

The Performance Verification Tests in this chapter are intended to verify proper operation of the M4735A following repair. The level of testing required corresponds to the type of repair performed, and is divided into 3 categories: **External/No Trouble Found**, **Printer Replacement**, and **Internal Repairs**. Each of these categories is described below.

External Repairs/No Trouble Found

External Repairs are those involving the repair or replacement of one or more of the items below. **No Trouble Found** applies when no malfunction can be found, or when the problem appears to be due to improper use. In either situation, the key point is that ***the case has not been opened.***

- External paddles
- Internal paddles and/or adapter cable
- Paddle holders
- Pads adapter cable
- ECG cable
- SpO_2 cable or sensor
- Battery
- Labels
- AC Power cord
- Consumables (ECG monitoring electrodes, multifunction defibrillation pads, printer paper)
- Main fuse (on Battery PCA)
- Data Card Door Assembly
- Battery Eject Assembly

The following testing is required after an **External Repair** or when the outcome of the service is **No Trouble Found** ***(when the case has not been opened)***:

- Perform the Visual Inspection (page 2-15).
- Run the Extended Self Test (page 2-22).
- Print and Verify the System Log (page 2-20).

Printer

If the printer was replaced, ***and the case was not opened,*** the following tests are required:

- Perform the Visual Inspection (page 2-15).
- Run the Extended Self Test (page 2-22).
- Run the Printer Test (page 2-27).
- Print and Verify the System Log (page 2-20).

Internal Repairs

If the case was opened (regardless of what the repair involved), all of the Performance Verification Tests must be performed, beginning with "Visual Inspection" on page 2-15.

Test Matrix

The matrix in Table 2-1 summarizes performance verification tests and inspections for the M4735A; including test name, test or inspection to perform, expected test results, and data to record.

Table 2-1 Performance Verification and Safety Tests

Test Group Name	Test or Inspection to Perform	Expected Test Results	Data to Record x = p (pass) or f(fail)
Visual Inspection (V)	**Inspect unit, accessories, cables, etc. as described on page 2-15.**	• No unusual damage, no corrosion: x=p.	V:x *Example V:p*
Functional Checks (F)	In normal Operating Mode, perform the following functional checks: • ECG (page 2-16). • Shock Advisory (page 2-17). • Synchronized Cardioversion (page 2-18). • SpO_2 (page 2-18).	• All functions respond as expected • Waveform clear on display; HR correct on display; HR alarm works • Shock Advised only when appropriate • Shock delivered with correct timing • 95% -100%	F:x Example F:p
Extended Self Test (X)	**In Diagnostic Mode, run the Extended Self Test (page 2-22). Includes Data Card Test and time/date check.**	"Pass" reported on all tests applicable to the device configuration and options: x=p.	X:x *Example X:p*
User Interface Tests (U)	**• In Diagnostic Mode, run the following tests (page 2-25):** • Controls Test • Display Test • Audio Test • Printer Test	All responses as expected. • All keys respond as expected • Visual Pass assessment by service personnel • Audio Pass assessment by service personnel. • Print quality: visual Pass assessment by service personnel • Print speed: 25 mm ± 5% (1.25mm)	*U:x* *Example: U:p*

Table 2-1 Performance Verification and Safety Tests

Test Group Name	Test or Inspection to Perform	Expected Test Results	Data to Record x = p (pass) or f(fail)
ECG Tests (E)	**In Diagnostic Mode, run the ECG Tests (page 2-29):**	All data within limits, all checks pass: x=p	E: aaaa,bbbb,cc,dd, ee,ffff,x *Example: E:1000,1000,20,20, 50,2000,p*
	• Status messages (lead, pad, DSP)	• "Good" displayed for all three	
	• DC offset	• Ignore - used only in factory manufacturing.	
	Amplifier gain		
	• Pads Peak to Peak (Monitor) - aaaa	*• 1000mV ±10%*	
	• Leads Peak to Peak (Diagnostic) - bbbb	• 1000mV ±10%	
	Amplifier noise		
	• Leads Peak to Peak (Diagnostic) - cc	*• 0 ± 30uV*	
	• Pads Peak to Peak (Monitor) - dd	*• 0 ± 30uV*	
	PCI measurement		
	• PCI - Paddles in Pockets – ee	• 50 ± 30 Ω	
	• PCI - Paddles open – ffff	• ≥ 1250 Ω	
Pacing Test (P)	**In Diagnostic Mode, run the Pacing Test (page 2-33):**		P:aa,bbb *Example: P:31,198*
	• 30 mA – aa	• 30 mA ± 5 mA	
	• 200mA – bbb	• 200mA± 20 mA	

Table 2-1 Performance Verification and Safety Tests

Test Group Name	Test or Inspection to Perform	Expected Test Results	Data to Record x = p (pass) or f(fail)
Defibrillator Test - AC Power (DA) (if AC Power used in normal operation)	**Using only AC power, enter Diagnostic Mode and run the Defibrillator Test (AC Power at 200J) (page 2-35):**		DA:aaa,bbbbb,ccc,dd *Example:* *DA:198,13000,195,48*
	Measured by Defibrillator Analyzer:		
	• Delivered energy - aaa	• 200 ± 30J	
	Displayed by M4735A:		
	• Available Energy after Shock	• 0	
	• Msec to charge – bbbbb	• ≤ 15000 msec	
	• Delivered energy - ccc	• Actual delivered energy (aaa) ±7%	
	• Impedance - dd	• 42 to 57 Ω	
	• Defib errors	• None (0)	
Defibrillator Test - Battery Power (DB)	**Using only battery power, enter Diagnostic Mode and run the Defibrillator Test (Battery Power at 200J) (page 2-36).**		DB:aaa,bbbb,ccc,dd *Example:* *DB:198,2545,200,50*
	Measured by Defibrillator Analyzer		
	• Delivered energy - aaa	• 200 ± 30 J	
	Displayed by M4735A		
	• Available Energy after Shock	• 0	
	• Msec to charge – bbbb	• ≤ 3000 msec	
	• Delivered energy - ccc	• Actual delivered energy (aaa) ±7%	
	• Impedance - dd	• 42 to 57 Ω	
	• Defib errors	• None (0)	
Defibrillator Disarm Test (D)	**Enter Diagnostic Mode and run the Defibrillator Disarm Test (page** 2-38)	All readings as expected: x=p	D:x *Example: D:p*

Table 2-1 Performance Verification and Safety Tests

Test Group Name	Test or Inspection to Perform	Expected Test Results	Data to Record x = p (pass) or f(fail)
Safety Test (S)	**Test both leads and pads, and indicate test results as follows:** **External Leads: t=C** **External Pads: t=B**		S:aaa,bbbb, t,ccc,ddd,eeee,fff,ggg; t,ccc,ddd,eeee,fff,ggg *Example: S:125,150,* *C,10,40,40,10,40;* *B,90,150,2500,90,250*
	Earth Leakage		
	Earth Leakage (Normal Condition) - aaa	≤ 500 uA (≤ 300 uA UL)	
	Earth Leakage (Single Fault) - bbbb	≤ 1000 uA	
	Patient Lead Leakage	CF/ BF Applied Parts	
	• Source (Normal Condition) - ccc	≤ 10 uA/100 uA	
	• Source (Single Fault Condition) - ddd	≤ 50 uA/500 uA	
	• With Mains on applied part (Single Fault condition) - eeee	≤ 50 uA/5000 uA	
	• Auxiliary (Normal Condition) - fff	≤ 10 uA/100 uA	
	• Auxiliary (Single Fault Condition) - ggg	≤ 50 uA/500 uA	
	Note: All leakage current tests include both Normal and Reverse Polarity Conditions. Report worst case values.		

Note: When recording test results, separate results within a test by commas; separate tests by a semicolon (;); and use no empty spaces. For example:

V:x;F:x;X:x;U:x;E: aaaa,bbbb,cc,dd,ee,ffff,x;P:aa,bbb;
DA:aaa,bbbbb,ccc,dd;DB:aaa,bbbb,ccc,dd;D:x;
S:aaa,bbbb,t,ccc,ddd,eeee,fff,ggg;t,ccc,ddd,eeee,fff,ggg

V:p;F:p;X:p;U:p;*E:1000,1000,20,20,50,2000,p;P:31,198;*
DA:198,13000,195,48;DB:198,2545,200,50;D:p;
S:125,150,C,10,40,40,10,40;B,90,150,2500,90,250

Test Equipment

Table 2-2 lists the equipment needed to perform the Performance Verification tests, and provides specifications for commercially available analyzers and simulators. Test equipment is called out within each test procedure when needed. In addition, a digital voltmeter is also useful.

A 50 ohm test load is available from Agilent Technologies (M1781A).

Table 2-2 Equipment List

Equipment/Test	Specifications
ECG Simulator	
Calibrated Leads ECG simulator	
• Amplitude accuracy	±2%
• Rate accuracy	±2%
Calibrated Paddles ECG simulator	
• Amplitude accuracy	±2%
• Rate accuracy	±2%
Defibrillator Analyzer	
Waveform compatibility	Meets all specs below using biphasic truncated exponential waveform.
Load resistance:	50 Ω ±1% (non-inductive)
Maximum energy:	≥ 200 joules
Maximum voltage:	≥ 2500 V
Maximum current:	≥50 A
Measurement accuracy:	
• ≥ 20 joules:	≤ ±2% of reading
• < 20 joules:	≤ ±0.4 joules
Cardioversion measurement range:	–150 to +150 ms

Table 2-2 Equipment List

Equipment/Test	Specifications
Pacer tester	
Load impedance:	≤400 Ω
Current measurement accuracy	
• 30 mA–50 mA:	<±2 mA
• 50 mA–200 mA:	<±4%
Rate measurement accuracy	
• 40–180 ppm:	<±0.5%
Waveform duration accuracy:	
• 40–180 ppm:	±1ms

Configuration and Diagnostic Modes

The instructions below describe how to enter Configuration Mode and Diagnostic Mode.

Configuration Mode

These instructions describe briefly how to use Configuration Mode. See the ***User's Guide*** for details on configuration settings and what effect they have.

1. **Power off.**

   Make sure the unit's power is off.

2. **Insert a Data Card.**

   If you intend to save the configuration to a Data Card (or load the configuration from a Data Card), insert the Data Card now.

NOTE

To avoid possible confusion, designate one Data Card as the "Configuration Card" and label it clearly. Keep this card physically separate from cards used by the clinical staff for data storage.

3. **Enter Configuration Mode.**

   Press softkeys 4 and 5 at the same time, and hold them down while turning the power on. See Figure 2-1 for softkey numbering.

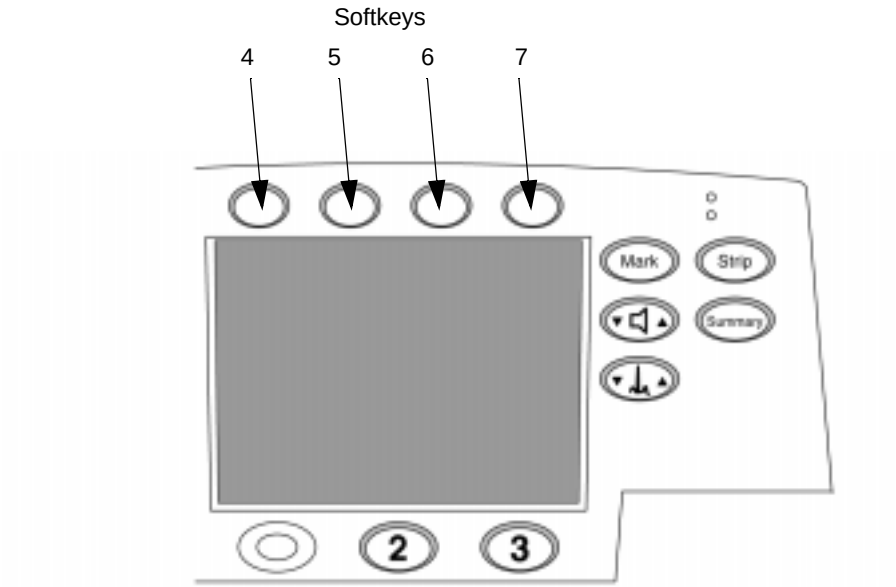
4. **Select and manage Configuration choices.**

   - To select a configuration, press the ▲ and ▼ softkeys to move up or down the list until the desired **Settings** item is highlighted. Then press the ENTER softkey to access those settings.
   - To print out a strip with all the current configuration choices, select **Print All Settings** and press ENTER.
   - To store the configuration settings on a data card, select **Save Settings to Data Card** and press ENTER. When prompted with **Save Settings to Data Card?** press SAVE.
   - To load configuration settings from a Data Card, select **Load Settings from Data Card** and press ENTER. When prompted with **Load Settings from Data Card?** press LOAD.

5. **Exit Configuration Mode.**

   To exit Configuration Mode, turn the unit off. Remove the Data Card.

Figure 2-1 Softkey Numbers



Diagnostic Mode

These instructions describe how to enter Diagnostic Mode. Once in Diagnostic Mode, you can do the following:

- Print the System Log. See "System Log" on page 2-20.
- Run the Extended Self Test. See "Extended Self Test" on page 2-22.
- Run other Diagnostic Tests. See "Diagnostic Tests" on page 2-19.

1. **Power off.**

   Make sure the unit's power is off.

2. **Enter Diagnostic Mode.**

   Press softkeys 4 and 6 at the same time, and hold them down while turning the power on. See Figure 2-1 for softkey numbering.

3. **Wait for the unit to initialize.**

   This may take several seconds. The unit is ready to proceed when the screen cursor responds to softkey inputs.

4. **Select the desired test or function.**

   To select a test, press the ▲ and ▼ softkeys to move up or down the list until the desired test is highlighted. Then press the ENTER softkey to start that test.

5. **Exit Diagnostic Mode.**

   To exit Diagnostic Mode, turn the unit off.

The Software Support Tool

The Software Support Tool (M4735-87890) allows field service personnel to perform 2 tasks: 1) to enable the SpO_2 option, and 2) to program in the serial number. These tasks need to be performed under the following circumstances:

- The Control PCA has been replaced.

  The Control PCA contains all the operating software, configured for the installed hardware. It also contains the unit's serial number, which was programmed in during manufacturing.

  The new Control PCA must be programmed to recognize the hardware installed in this unit, and to contain that unit's serial number.

- The unit has received an upgrade adding the SpO_2 capability.

  The added hardware will ***not*** be automatically recognized. The Control PCA must be programmed to recognize the new hardware installed.

Using the Support Tool

1. **Prepare the unit.**

   a. Have unit power off, and have either a fresh battery installed or the AC power cord plugged in.

   b. Insert the Support Tool data card into the unit.

   c. Turn unit power on.

2. **Follow the screen prompts.**

   a. Select whether SpO_2 hardware is installed or not as appropriate.

   b. Program in the unit's serial number.

      - If this is an SpO_2 upgrade, the serial number should already be present. In this case, verify it against the factory-applied label on the bottom of the case.
      - If this is a Control PCA replacement, program in the serial number found on the factory-applied label on the bottom of the case using the softkeys as instructed on the screen. Be sure to program it in accurately, as the serial number is used for all repair history tracking.

   c. Check all the displayed information carefully before proceeding.

      - If the displayed information is correct, follow the screen prompts to save the configuration.

- If any of the information is incorrect, follow the prompts to NOT save the configuration, then start over by powering the unit off, then back on.

3. **Turn off the power and remove the Data Card.**

4. **Check the customer configuration.**

   a. Turn the unit back on and enter Configuration Mode (see "Configuration Mode" on page 2-10).

   b. Print the configuration and check it against the printout from before the servicing began. Reset the configuration (or load it from a Data Card) as needed.

5. **Verify performance.**

   Perform Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Performance Verification

This section gives instructions for running Performance Verification tests on the M4735A. The tests are sequenced to check more basic functions first, and then build on that to check more complex functions. We recommend you perform these tests in this sequence. If desired, you can make copies of the Test Results Matrix (page 2-4) and use it to record results.

The Performance Verification tests include:

Section	Page
Visual Inspection	2-15
Functional Checks	2-16
Diagnostic Tests	2-19
Safety Tests	2-39
Battery Capacity Test	2-40

Visual Inspection

1. **Inspect the unit.**

   Inspect the entire unit, especially paddles, power cord, printer, battery, cables, and sensors for signs of the following.

   - Wear or damage to paddles, cables, and adapters.
   - Wear or damage to patient cables and associated strain reliefs.
   - Mechanical damage to case, membrane switches, speaker cover, ambient light sensor cover, display window.
   - Loose or missing hardware.
   - Evidence of liquid spill. Check inside the printer bucket and clean out any accumulation using gloves and an approved cleaner.
   - Residue on the thermal printhead.
   - Printer roller wear.
   - Wear or damage to power cord and associated strain relief.
   - Corrosion on connector pins, printer parts, or battery contacts.

   Pass: Only normal wear, no damage serious enough to inhibit performance. No corrosion visible.

2. **Check the consumables.**

   Check the ECG electrodes and defibrillator pads for freshness (data code or expiration date) and condition.

   Pass: Electrodes and pads are within their expiration date and appear usable. Packaging is unopened and shows no tears or punctures. No corrosion visible on connector sockets, electrodes, or pads.

Functional Checks

The following functional checks exercise the basic functions of the defibrillator/monitor. They are intended as a broad check of the unit's performance, and are designed to complement (not replace) the Diagnostic Tests described later.

If all elements of a test pass, record that test as a PASS and return to the main diagnostic menu by pressing MAIN. If there is any failure, begin troubleshooting and repairing as needed. See "Troubleshooting" on page 3-1.

The Functional Checks include:

Check	Page
ECG Functional Checks	2-16
Shock Advisory Functional Check	2-17
Synchronized Cardioversion Functional Check	2-18
Sp02 Functional Check	2-18

ECG Functional Checks

This section describes how to check the operation of the ECG functions. Each of the ECG checks assumes the unit and the simulator are still set up as they were at the end of the previous ECG check.

To check ECG display and Heart Rate (HR) functions:

1. **Set up the simulator.**
   a. Connect the ECG simulator to both the Pads input and the 3- or 5-lead ECG cable.
   b. Set the simulator for normal sinus rhythm (NSR), 1mV amplitude, at some nominal rate (e.g., 60 bpm).
2. **Set up the M4735A.**

   Set the M4735A to Manual operating mode (not Diagnostic Mode).
3. **Check the displayed ECG.**

   Using the LEAD SELECT softkey, verify that the display shows a normal ECG with a clean baseline for both Pads and Lead II.
4. **Check the Heart Rate (HR).**

   Verify that the Heart Rate (HR) displayed is correct.
5. **Check Leads Off.**
   a. Disconnect the ECG simulator from the pads cable and verify that the display shows a dashed line in place of the waveform and that the unit both alarms and gives the **Pads Off** message
   b. If using a 5-lead ECG cable, set the unit to monitor from the V lead.

c. Disconnect each of the ECG leads from the simulator one at a time, and verify that the display shows a dashed line in place of the waveform and that the unit both alarms and gives the **Leads Off** message.

To check ECG printing functions:

6. **Reconnect the simulator.**

   Connect the simulator to the M4735A as described in step 1 above.

7. **Print a strip.**

   a. Print a strip; verify that it shows a normal ECG with a clean baseline.

   b. Verify that the date, time, and configuration information printed at the top of the strip is correct.

Shock Advisory Functional Check

This section describes how to check the Shock Advisory function.

1. **Set up the simulator.**

   a. Connect the ECG simulator to the pads cable.

   b. Set the simulator for normal sinus rhythm (NSR), 1mV amplitude, at some nominal rate (e.g., 60 bpm).

2. **Set up the M4735A.**

   Set the M4735A to AED Mode.

3. **Check Shock Advisory with NSR.**

   a. Press ANALYZE .

   b. Verify that the defibrillator responds with **No Shock Advised**.

4. **Check Shock Advisory with Asystole.**

   a. Set the simulator to Asystole (or turn the simulator off) and press ANALYZE .

   b. Verify that the defibrillator still responds with **No Shock Advised**.

5. **Check Shock Advisory with VF.**

   a. Set the simulator to VF (Ventricular Fibrillation) and press ANALYZE .

   b. Verify that the defibrillator responds with **Shock Advised** and charges up to 150J. If the unit is configured to do so, verify that it automatically prints a strip of the event.

WARNING **Do not discharge the stored energy unless you are certain the simulator contains a 50 ohm test load.**

c. If the simulator contains a 50 ohm test load, discharge the stored energy into the test load. If it does not, or you are not sure, wait until the defibrillator reports **Shock cancelled** before proceeding.

Synchronized Cardioversion Functional Check

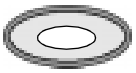
This section describes how to check the synchronized cardioversion function.

1. **Set up the simulator and the analyzer.**

   a. Connect the ECG simulator to the ECG cable. Connect the defibrillator analyzer to the pads cable.

   b. Set the simulator for normal sinus rhythm (NSR), 1mV amplitude, at some nominal rate (e.g., 60 bpm).

2. **Set up the M4735A.**

   Set the defibrillator to Manual Mode, and press  .

3. **Check Cardioversion.**

   a. Verify that sync markers appear on the display, at the peak or on the falling side of the QRS complex. Adjust the size of the displayed ECG as needed to view it more clearly.

   b. Select an energy of 5 J. Press CHARGE then press and hold SHOCK until the shock is delivered (at next QRS).

   c. Verify on the defibrillator analyzer that the shock was delivered, and was 5J ±2J.

   d. If the unit is configured to do so, verify that it prints a strip with the correct information on it (waveform, text).

   e. Verify on the defibrillator analyzer that the delay between the peak of the QRS and the delivered shock was $\leq$60 msec.

SpO_2 Functional Check

This check only needs to be performed if SpO_2 is installed.

1. **Connect the sensor.**

   Attach the SpO_2 transducer to your finger and connect it to the M4735A.

2. **Check SpO_2.**

   a. Activate Manual Mode and press the SpO_2 softkey to turn SpO_2 on.

   b. The SpO_2 value displayed should be in the range of 95-100%. If the value is less than 95%, check that your finger is fully inserted into the sensor and properly positioned.

Diagnostic Tests

The M4735A includes an extensive set of Diagnostic Tests, which test the major hardware components of the defibrillator.

The Diagnostic Tests include:

Test	Page
System Log	2-20
Extended Self Test	2-22
User Interface Tests	2-25
ECG Tests	2-29
Pacing Test	2-33
Defibrillator Test (AC Power At 200 J)	2-35
Defibrillator Test (Battery Power At 200 J)	2-36
Defibrillator Disarm Test	2-38

System Log

The System Log includes the unit's serial number, hardware configuration, and a listing of error codes. The System Log should be printed each time a Performance Verification Test is run.

1. **Enter Diagnostic Mode.**

   See "Diagnostic Mode" on page 2-11.

2. **Print the System Log.**

   a. Select **Print Log** and press ENTER.

   b. The printer will print the System Log strip. See "Sample System Log Printout" on page 2-21.

3. **Check the System Log.**

   a. Check hardware and options.

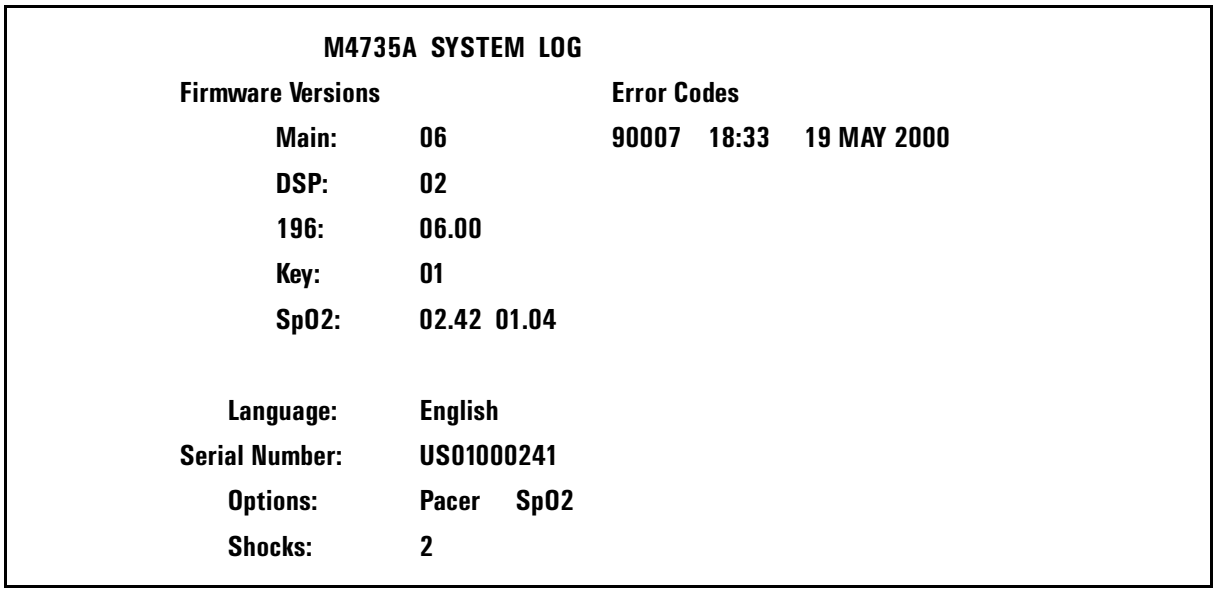
   - Check the printout to verify the printed results are consistent with the hardware in place. Check options installed (SpO_2, pacing) and the unit's serial number (on the bottom of the case).
   - If the printout is not correct, investigate and resolve the source of the mismatch. Then reset the hardware options and serial number as needed using the Support Software Tool. See "The Software Support Tool" on page 2-12.

   b. Check for M4735A errors.

   If there are device errors reported in the System Log:

   - Check the time and date stamps to see if they are recent errors or not.
   - Consult Table 3-2 "Error Codes" on page 3-10 to identify the errors.
   - Begin troubleshooting as needed (See "Troubleshooting" on page 3-1.)

Figure 2-2 Sample System Log Printout



M4735A SYSTEM LOG

Firmware Versions		Error Codes
Main:	06	90007 18:33 19 MAY 2000
DSP:	02	
196:	06.00	
Key:	01	
SpO2:	02.42 01.04	
Language:	English	
Serial Number:	US01000241	
Options:	Pacer SpO2	
Shocks:	2	

Extended Self Test

The Extended Self Test checks that all internal processors are operating and communicating with each other.

If all results are as described, the unit passes this test. Return to the main Diagnostic Test menu by pressing MAIN.

If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1, and Table 3-6 "Extended Self Test Failures" on page 3-17.

NOTE

Be sure the printer has paper and that the printer door is closed. No paper or an open door will generate an erroneous **Fail** in the **Timebase** test.

1. **Connect the test load to the pads cable.**
2. **Access the Diagnostic Test menu.**

   See "Diagnostic Mode" on page 2-11.
3. **Run the test.**

   Select **Extended Self Test** and press ENTER. The printout should appear similar to Figure 2-3.

Figure 2-3 Sample Extended Self Test Printout

M4735A EXTENDED SELF TEST 18:48 5/19/2000

RAM:	Pass
ROM:	Pass
System:	Pass
Data Card:	Not Tested
CODEC:	Pass
IRDA:	Not Tested
Timebase:	Pass
Defib:	Pass
FE:	Pass
SpO2:	Pass
Pacer:	Pass

4. **Check the results.**

   a. Check the time and date.

   - Check the printout to verify that the time and date are correct.
   - If they are not, reset them using the Configuration Mode. See "Configuration Mode" on page 2-10.

   b. Check the test results.

   The results of the following tests will appear on the display and on the printout:

   - **RAM**

     Tests the Read Only Memory (ROM).

   - **ROM**

     Tests the Random Access Memory (RAM).

   - **System**

     Tests the integrity of the core processing system and checks the Lithium backup battery.

   - **Data Card**

     The Data Card test writes a small file to the data card, reads it back and checks it, then erases that file. If no Data Card is present, the test result will be **Not Tested**.

   - **CODEC**

     The processor turns on the CODEC (coding/decoding) chip (used for voice prompts), and gets an acknowledgement that it's ready to receive data. It does not give the CODEC actual data to process.

   - **IRDA**

     Tests the infrared communications port. If no active infrared device is within range, the test result will be **Not Tested**.

   - **Timebase**

     The Timebase test compares the Real Time clock to the System clock to check for discrepancies. It does not test the SpO_2 clock or the Biphasic clock.

- **DEFIB**

  The Defib test charges the defibrillator capacitor and then disarms it. It does not deliver the energy outside the unit. The pads cable and test load must be connected for the test to run; otherwise the test result will be **Not Tested.**

- **FE**

  The Front End (FE) test checks that the main processor is communicating with the Digital Signal Processor (DSP), and that the DSP is communicating with both ECG front ends (pads and leads). It does not test the quality of the ECG measurement.

- **SPO2** (if SpO_2 option installed)

  This tests that communication with the SpO_2 PCA is working. It does this by reading the software revision back from the PCA. It does not test the quality of the SpO_2 measurement.

- **Pacer** (if Pacing option installed)

  The Pacer test has the Pacer deliver current into the test box, and measures that the current delivered was what was expected. The pads cable and test load must be connected for the test to run; otherwise the test result will be **Not Tested.**

User Interface Tests

The User Interface Tests exercise the functions that interact with the user. Each of the User Interface tests assumes the unit and the simulator are still set up as they were at the end of the previous User Interface check.

If all results are as described, the unit passes that test. Return to the main Diagnostic Test menu by pressing MAIN.

If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and the following specific tables:

- Table 3-11 "Operational Problems - Printer" on page 3-25.
- Table 3-12 "Operational Problems - Display" on page 3-26.
- Table 3-13 "Operational Problems - Audio Tones/Voice Prompts" on page 3-27.
- Table 3-14 "Operational Problems - Keys" on page 3-28.

To test the Controls (keys):

1. **Access the Diagnostic Test menu.**

   See "Diagnostic Mode" on page 2-11.

2. **Start the Controls Test.**

   Select **Controls Test** and press ENTER. The screen will display a map of the front panel keys.

3. **Test the softkeys.**

   Press each of the numbered softkeys in turn. See Figure 2-1 on page 2-11 for numbering of softkeys. Each softkey number on the display should be highlighted each time that key is pressed.

   Don't press Softkey #4 MAIN at this time. This will return you to the Main diagnostic mode menu.

4. **Test the ECG and Audio keys.**

   Test each of the **ECG Size** and **Volume** keys. See Figure 2-1 on page 2-11 for location of these keys.Each key should show a highlighted ⊞ ("plus") when the up arrow on the key is pressed, and show a highlighted ⊟ ("minus") when the down arrow is pressed.

5. **Test the printer keys.**

   Test each of the printer control keys (**Strip**, **Summary**, and **Mark**). Each corresponding label on the display should be highlighted each time that key is pressed.

6. **Test the pacing keys.**

   Test each of the Pacing keys. The displayed labels for **Pacer**, **Start/Stop** and **Mode** should be highlighted each time that key is pressed. The dis-

played labels for **Rate** and **Output** should show a highlighted ⊞ ("plus") when the up arrow on the key is pressed, and show a highlighted ⊟ ("minus") when the down arrow is pressed.

7. **End the test.**

   Press Softkey #4 MAIN to return to the Main diagnostic mode menu.

To test the display:

1. **Run the Display Test.**

   Select **Display Test** and press ENTER.

   The display should turn completely light, then completely dark, then a light vertical bar should scroll across the screen from left to right.

2. **Test the LEDs.**

   The display will show a TEST LEDs softkey label. Press this softkey and verify that the indicators in the Main and Pacing keypads each light in turn. The **AC Power** and **Batt Charge** LEDs will ***not*** light as part of this test.

3. **End the test.**

   Press Softkey #4 MAIN to return to the Main diagnostic mode menu.

To test the audio output:

1. **Start the Audio Test.**

   Select **Audio Test** and press ENTER. The screen will display the **Audio Test** menu.

2. **Select and run the desired test.**

   a. Press the ▲ and ▼ softkeys to move up or down the list to select the desired test. Then press ENTER to begin that test.

      Check the **Shutdown Warning** and the **Voice Prompt**; the other responses are given for reference. The results should be as described below.

      Press CANCEL to end that test and return to the main audio test menu.

      - **Message Alert** - A repeating series of 3 short tones, followed by a pause.
      - **Heart Rate Alarm** - 1 sustained tone of moderately high pitch.
      - **Charge Done Tone** - 1 sustained tone of lower pitch than the Heart Rate Alarm.
      - **Auto Disarm Warning** - A repeating series of 1 short tone and a pause.

- **Shutdown Warning** - A repeating series of tones of alternating high/low pitch.
- **Voice Prompt** - Voice should be clear and understandable.

3. **End the test.**

   Press Softkey #4 MAIN to return to the Main diagnostic mode menu.

To test the printer:

1. **Start the Printer Test.**

   a. Select **Printer Test** and press ENTER.

2. **Check the print quality.**

   a. Verify that the test patterns on the strip are as indicated in Figure 2-4.

   b. Check for white lines (printhead elements stuck off) or black lines (printhead elements stuck on).

   c. Check area "A" for stray marks or lines.

   d. The area of Figure 2-4 labeled "C" contains printouts of all characters and symbols. Verify that they are readable.

3. **Stop the printout.**

   Press CANCEL to end the test and return to the main Diagnostic Test menu.

4. **Verify the print speed.**

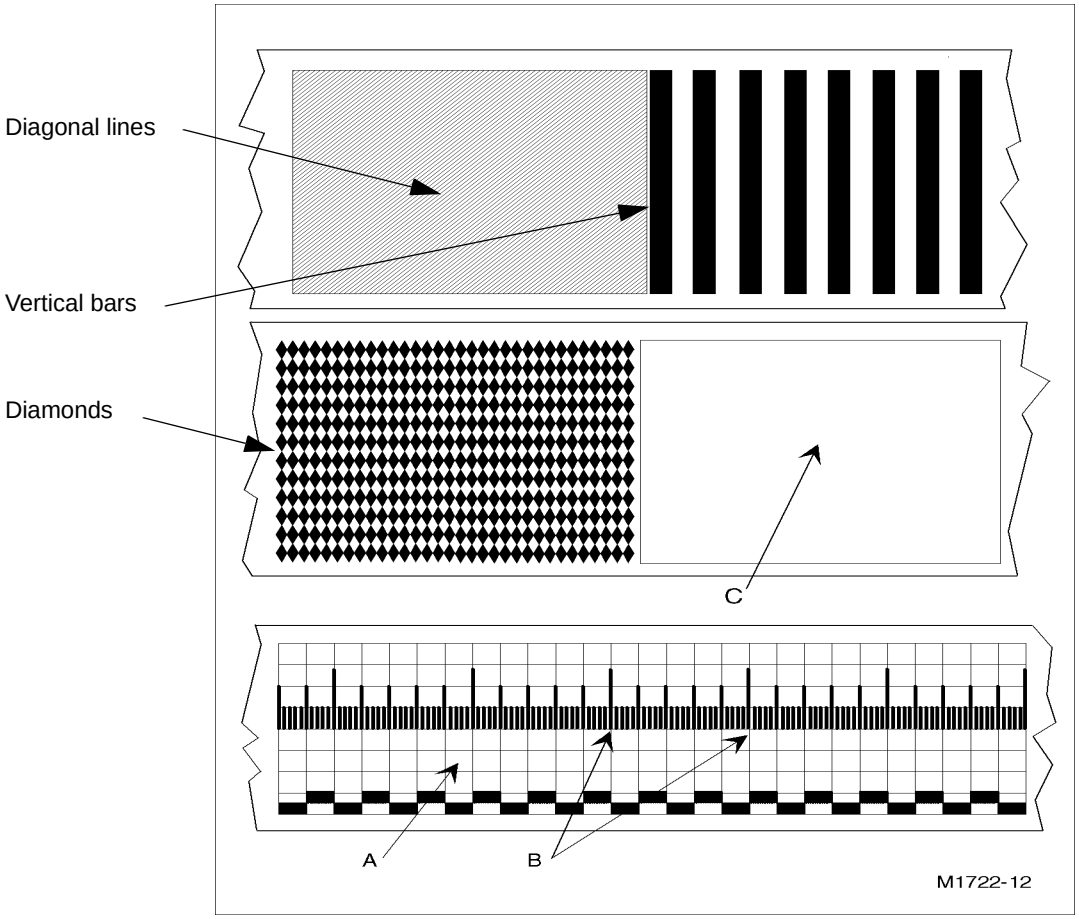
   Measure between the long tick marks (B in Figure 2-4) to verify paper speed. Distance should be 25mm ± 5% (±1.25 mm).

5. **Check the printer status detection.**

   a. Open the printer door and press the **Strip** key. The unit should sound a series of 3 tones indicating a printer problem.

   b. Take out the paper, close the door, and press the **Strip** key. The unit should sound a series of 3 tones indicating a printer problem.

Figure 2-4 Printer Test Output



ECG Tests

These instructions describe how to test the ECG functions.

Each of the ECG tests assumes the unit and the simulator are still set up as they were at the end of the previous ECG test.

If all results are as described, the unit passes that portion of the test. Return to the main Diagnostic Test menu by pressing MAIN.

If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and Table 3-7 "Operational Problems - ECG Monitoring (Pads or Leads)" on page 3-18.

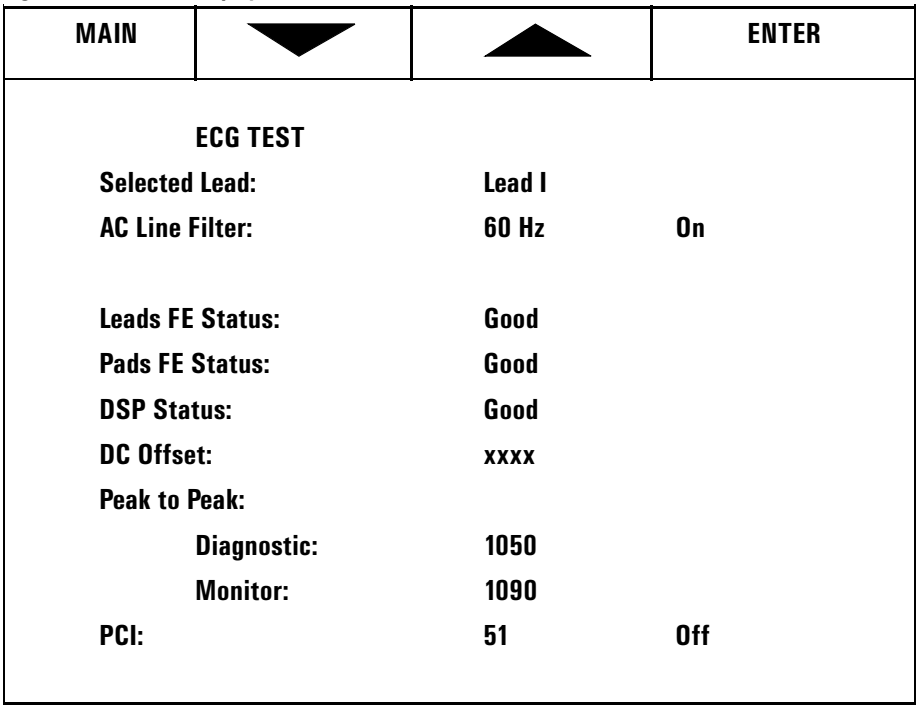
1. **Start the test.**

   a. Access the Diagnostic Test menu as described in "Diagnostic Mode" on page 2-11.

   b. Select **ECG Test** and press ENTER.

   c. The display should look similar to Figure 2-5:

Figure 2-5 ECG Test Display



2. **Check the settings.**

   a. **AC Line Filter**

   The AC Line Filter should be set to the correct frequency for your area.
   If the setting is incorrect, access the Configuration Mode and correct it. See "Configuration Mode" on page 2-10.

b. **Selected Lead**

This setting does not matter at this point. It will be changed later.

3. **Change the settings as needed.**

a. To temporarily change the settings of **Selected lead** or **AC Line filter**, press the ▲ and ▼ softkeys to highlight the parameter, then press (and release) ENTER to select it.

NOTE

The available choices for Selected Lead will depend on whether the unit is configured for 3-lead or 5-lead ECG monitoring.

b. After a few seconds the highlighted selection will begin to blink, and the ▲ and ▼ softkeys will allow you change the selection to another of the values available. When the value you want is displayed, press ENTER to set that value.

NOTE

These changes are only temporary, and will not override the configuration set in Configuration Mode.

4. **Check the ECG Status messages.**

The 3 status messages (**Lead FE, Pad FE, DSP**) should all be **GOOD**.

- The **Leads FE** test checks that communication is working between the Leads Front End (FE) and the Digital Signal Processor (DSP).
- The **Pads FE** test checks that communication is working between the Pads FE and the DSP.
- The **DSP** test checks that communication is working between the DSP and the rest of the monitor.

5. **DC Offset.**

This test is for manufacturing use only and should be ignored.

6. **Test the ECG amplifier.**

These tests measure both the gain and the noise of the two ECG amplifiers (Leads and Pads). Both use the **Peak to Peak** reading.

The **Peak to Peak** reading measures the peak to peak amplitude of the signal appearing on the selected ECG input. If the simulator's calibrated output is 1.0 mV, then the **Peak to Peak** reading should be 1000 ± 10% (±100) for both **Monitor** and **Diagnostic**. If the simulator output is calibrated to some other value, the displayed value should be (1000 x simulator output) ±10%.

NOTE

The diagnostic frequency response is only available when using the ECG Leads input. When the unit is set to **Pads**, the display will indicate dashes (-----) for the **Diagnostic Peak-to Peak** value.

a. Perform the amplifier gain test:

1. Connect the ECG simulator to the pads cable. Set the simulator output for sine wave, 2 Hz or 10 Hz, 1 mV peak-to-peak.
2. Following the instructions under Step 3 on page 2-30 for changing settings, set **Selected lead** to **Pads**. Only the **Monitor** frequency response will be available.
3. Wait for the displayed value under **Monitor** to stabilize.
4. The displayed value should be 1000 ±10% (±100). Record this as "aaaa".
5. Connect the ECG simulator to the ECG leads cable.
6. Following the instructions under Step 3 on page 2-30 for changing settings, set **Selected lead** to **Lead II**.
7. Wait for the displayed value under **Diagnostic** to stabilize.
8. The displayed value should be 1000 ±10% (±100). Record this as "bbbb".

b. Perform the amplifier noise test:

1. Turn the simulator off. Leave it connected to the ECG cable, and leave **Selected lead** set to **Lead II**.
2. Wait for the displayed value under **Diagnostic** to stabilize.
3. The displayed value should be 0 ± 30 uV. Record this as "cc".

   If the unit exhibits more than 30 uV of noise, try repositioning the cable or unit to minimize external interference. Also try various combinations of having the ECG simulator turned on or off, and (if applicable) whether the simulator is plugged into the AC mains. Refer to Chapter 7 for more information about reducing electromagnetic interference.
4. Following the instructions under Step 3 on page 2-30 for changing settings, set **Selected lead** to **Pads**.
5. Connect the simulator to the pads cable.
6. Wait for the displayed value under **Monitor** to stabilize.
7. The displayed value should be 0 ± 30 uV. Record this as "dd".

7. Test the PCI function.

This test checks the PCI (Patient Contact Indicator) function. The PCI measurement is used to detect Pads Off and Paddles Off, and to light the Patient Contact Indicator LEDs on PCI-equipped paddle sets. It is an approximate measurement only - the impedance value used to adjust the defibrillation waveform is a separate measurement, made during delivery of the shock. See "Theory of Operation" beginning on page 6-1 for more details.

a. Connect a set of external paddles to the M4735A.

b. If the PCI setting is **On**, turn it **Off** now by pressing the Volume Up and Down arrow keys simultaneously. (See Figure 2-1 on page 2-11.)

c. Remove the paddles from their holders and hold them firmly together, face to face (metal-to-metal). Be sure the paddles clean and are making good contact with one another

d. Turn the PCI setting **On** by pressing the Volume Up and Down arrow keys simultaneously. (See Figure 2-1 on page 2-11.) The displayed PCI value should now read **0**.

e. Place the paddles back in their holders. Be sure the metal contact clip in the holder is clean and makes good contact with the face of the paddle.

f. The PCI measurement should now read 50 ohms ±30 ohms. Record this as "ee".

g. Remove the paddles from the holders and hold them apart. The PCI measurement should read > 1250 ohms (full scale). Record this as "ffff".

Pacing Test

These instructions describe how to test the pacing function. This test only needs to be run if the Pacing option is installed.

If all results are as described, the unit passes the test. Return to the main Diagnostic Test menu by pressing MAIN.

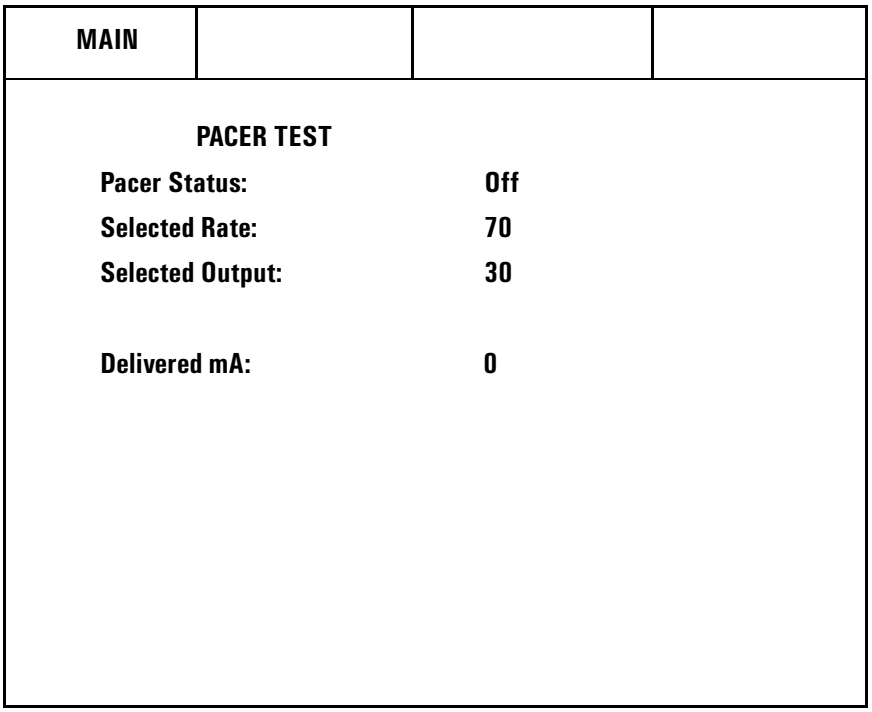
If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and Table 3-10 "Operational Problems - Pacing" on page 3-24.

1. **Set up the test.**

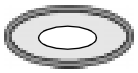
   a. Connect the defibrillator to the Pacer tester.

   b. From the Diagnostic Menu, select **Pacer Test** and press ENTER. The display should look similar to Figure 2-6.

Figure 2-6 Pacer Test Display



2. **Begin Pacing.**

   a. Press  . The LED to the left of the button will illuminate. The screen display of **Pacer Status** will change to **Stopped.**

   b. Press

. **Pacer Status** will change to **Pacing**, and pacing will begin at the default settings of 70 beats per minute (bpm) and 30 mA.

3. **Check the default output.**

   a. The Pacer should be delivering a current of 30mA ±5mA. Record the delivered current indicated by the Pacer tester as "aa".

   b. The display on the M4735A should read the delivered current as measured by the Pacer tester ("aa") ±5 mA.

4. **Test the maximum output.**

   a. Using the

button, increase the rate to 180 bpm.

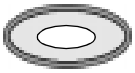
   b. Using the

button, increase the output to 200 mA.

   c. The Pacer should be delivering a current of 200mA ±20mA. Record the delivered current indicated by the Pacer tester as "bbb".

   d. The display on the M4735A should read the delivered current as measured by the Pacer tester ("bb") ±20 mA.

5. **End the test.**

   Turn off Pacing by pressing the  button.

Defibrillator Test (AC Power At 200 J)

These instructions describe how to test the defibrillation function when powered only by AC power (no battery installed).

If all results are as described, the unit passes the test. Return to the main Diagnostic Test menu by pressing MAIN.

If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and Table 3-9 "Operational Problems - Defibrillation and Synchronized Cardioversion" on page 3-21.

1. **Set up the test.**

   a. Turn defibrillator off and remove the battery. Connect the AC Power cord.

   b. Connect the defibrillator analyzer to the pads cable. Set the analyzer to measure delivered energy. If needed, reset the analyzer's display to read 0.

   c. Turn the defibrillator on, and from the Diagnostic Menu, Select the **Defib Meas Test** and press ENTER.

2. **Deliver a 200J shock.**

   a. Use the **Energy Select** control to select 200J.

   b. Press the CHARGE softkey to charge the defibrillator.

   c. Press SHOCK.

3. **Check the analyzer readings.**

   Read the delivered energy indicated by the defibrillator analyzer. It should be 200J ±15% (±30J). Record as "aaa".

4. **Check the values displayed by the M4735A.**

   The results displayed by the M4735A should be as follows:

Available Energy:	**Not recorded - failure if > 0.**	
ms to Charge:	**≤15000**	**(Record as "bbbbb")**
Delivered Energy:	**Actual delivered energy ("aaa") ±7%**	**(Record as "ccc")**
Impedance:	**42 to 57 ohms**	**(Record as "dd")**
Peak Current:	**Ignore. Derived from same measurements as delivered energy and impedance**	
Defib Errors:	**Not recorded - failure if any reported.**	
Shock Counter:	**Disregard.**	

Defibrillator Test (Battery Power At 200 J)

These instructions describe how to test the defibrillation function when powered only by a fully charged battery, with no AC power connected.

If all results are as described, the unit passes the test. Return to the main Diagnostic Test menu by pressing MAIN. If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1 and Table 3-9 "Operational Problems - Defibrillation and Synchronized Cardioversion" on page 3-21.

1. **Set up the test.**

   a. Turn the defibrillator off. Insert the battery and disconnect the AC Power cord.

   b. Connect the defibrillator analyzer to the pads cable. Set the analyzer to measure delivered energy. If needed, reset the analyzer's display to read 0.

   c. Turn the defibrillator on, and from the Diagnostic Menu, Select the **Defib Meas Test** and press ENTER.

2. **Deliver a 200J shock.**

   a. Use the **Energy Select** control to select 200J.

   b. Press the CHARGE softkey to charge the defibrillator.

   c. Press SHOCK.

3. **Check the analyzer readings.**

   Read the delivered energy indicated by the defibrillator analyzer. It should be 200J ±15% (±30J). Record as "aaa".

4. **Check the values displayed by the M4735A.**

   The results displayed by the M4735A should be as follows:

Available Energy:	**Not recorded - failure if > 0.**	
ms to Charge:	**≤3000**	**(Record as "bbbb")**
Delivered Energy:	**Actual delivered energy ("aaa") ±7%**	**(Record as "ccc")**
Impedance:	**42 to 57 ohms**	**(Record as "dd")**
Peak Current:	**Ignore. Derived from same measurements as delivered energy and impedance**	
Defib Errors:	**Not recorded - failure if any reported.**	

NOTE

If the "**ms to Charge**" measurement is too high (unit takes too long to charge), verify that the battery is fully charged. If it is, the battery may simply be old. The 3000 ms specification is defined for a new, freshly charged M3516A battery. Replace the battery with one that is new and fully charged, and repeat the test.

Defibrillator Disarm Test

These instructions describe how to test the disarm function.

If all results are as described, the unit passes the test. Return to the main Diagnostic Test menu by pressing MAIN. If there is any failure, begin troubleshooting and repairing the unit as needed. See "Troubleshooting" on page 3-1.

1. **Set up the test.**

   a. Turn the defibrillator off. Insert the battery and connect the AC Power cord.

   b. Connect the defibrillator analyzer to the pads cable. Set the analyzer to measure delivered energy. If needed, reset the analyzer's display to read 0.

   c. Turn the defibrillator on, and from the Diagnostic Menu, Select the **Defib Meas Test** and press ENTER.

2. **Charge and Disarm a 200J shock.**

   a. Use the **Energy Select** control to select 200J.

   b. Press the CHARGE softkey to charge the defibrillator.

   c. Press DISARM.

3. **Check the analyzer readings.**

   Read the delivered energy indicated by the defibrillator analyzer. It should be 0J or be blank.

4. **Check the values displayed by the M4735A.**

   The results displayed by the M4735A should be as follows:

Available Energy	**Not recorded - failure if > 0.**
Msec to charge	**Ignore - tested earlier**
Delivered energy	**Blank**
Impedance	**Blank**
Peak current	**Blank**
Defib errors	**Not recorded - failure if any reported.**

Safety Tests

This section covers tests of the defibrillator's electrical safety.

Using the procedures called out by the manufacturer of the analyzer in use, measure and record the following data. Only test at the AC Mains (line) voltage used in the customer's facility - there is no need to test both 120VAC and 240VAC. Also, test both Normal and Reverse Polarity line connections, and record the worst case value.

Earth Leakage

- Normal Condition - ≤ 500 uA (≤ 300 uA for UL)

  Record as "aaa".

- Single Fault Condition - ≤ 1000 uA

  Record as "bbbb".

Patient Lead Leakage

Test both Leads (C) and paddles/pads (B) inputs.

- Source (Normal Condition) - ≤ 10 uA (C), ≤ 100 uA (B)

  Record as "ccc".

- Source (Single Fault Condition) - ≤ 50 uA (C), ≤ 500 uA (B)

  Record as "ddd".

- With Mains on Applied Part (Single Fault Condition) - ≤ 50 uA (C), ≤ 5000 uA (B)

  Record as "eeee".

- Auxiliary (Normal Condition) - ≤ 10 uA (C), ≤ 100 uA (B)

  Record as "fff".

- Auxiliary (Single Fault Condition) - ≤ 50 uA (C), ≤ 500 uA (B)

  Record as "ggg".

Battery Capacity Test

The Battery Capacity Test is **not** part of the routine Performance Verification. It is included here for reference only.

To perform a Battery Capacity Test:

1. **Turn the M4735A off.**
2. **Label the unit.**

   Place a "Test in Progress" label on the unit to indicate to others that it may not be used.
3. **Insert a charged battery.**

   If an AC power cord is connected, unplug it now.
4. **Run the test.**

   a. While pressing **Mark** , turn power on to start the test.

   b. Allow the test to proceed to completion. The test takes approximately three hours and is complete when test results print out and the device turns itself off.
5. **Check results.**

   Review the test results and take the appropriate action, as follows:

Table 2-3 Battery Capacity Test Results

If	Then
Elapsed Time ≥ 2.5 hours and Low Battery Time ≥ 10 minutes	1. The battery passed the test. 2. Record "pass CT" and the date on the label on the bottom of the battery. 3. Recharge the battery before use.
Elapsed Time < 2.5 hours or Low Battery Time < 10 minutes	1. The battery failed the test. 2. Record "fail CT" and the date on the label on the bottom of the battery. 3. Discard the battery appropriately.

3 Troubleshooting

Overview

This chapter provides information for troubleshooting problems with the M4735A.

Chapter Contents

The major sections of this chapter are as follows:

Section	Page
Repair Philosophy	3-1
Equipment Required	3-1
Troubleshooting and Repair Methodology	3-2
Troubleshooting Tables	3-6
Calling for Service	3-31

Repair Philosophy

The repair philosophy of the M4735A is **subassembly replacement**. Examples of subassemblies are the printer, the Control PCA, and selected connectors and other items. Repairs that involve replacing individual components on a PCA are ***not*** supported.

CAUTION

Individual component replacement should ***not*** be attempted outside of a factory authorized repair facility. Component level repair is extremely difficult due to the extensive use of surface mount technology and the high parts-density on the circuit boards. Unauthorized component replacement can impair performance of the M4735A.

Equipment Required

Troubleshooting requires the same test equipment as does Performance Verification. See "Test Equipment" on page 2-8.

Troubleshooting and Repair Methodology

We recommend you follow the methodology described below to isolate and repair problems with the M4735A:

Section	Page
Methodology Overview	3-2
Initial Assessment	3-3
Diagnosing External Failures	3-4
Diagnosing Internal Failures	3-5

Methodology Overview

Interview the User

If possible, talk directly with the user who reported the problem. Identify what they were doing when the problem occurred, and exactly what happened. What was on the display? What tones or voice prompts were heard? Were there operational problems?

Identify the Problem

First, evaluate the unit's condition using the steps in "Initial Assessment" on page 3-3. Then use "Diagnosing External Failures" on page 3-4 to identify problems that can be resolved without further troubleshooting. Finally, if needed use "Diagnosing Internal Failures" on page 3-5 to isolate the problem to a particular subassembly.

If no trouble is found, proceed to the "Performance Verification and Safety Tests" chapter for instructions on tests to run.

Perform the Repair

Follow the procedures in the "Removal and Replacement" chapter to replace any defective subassemblies.

When the repair is complete, it is good practice to check the repair by attempting to reproduce the specific problem found. It is also advisable to print the System Log again to check that no errors have been logged after the repair.

Test the Unit

Use the procedures found in the "Performance Verification and Safety Tests" chapter to verify that the unit is operating properly overall. Be sure the testing performed is appropriate for the level of repair.

Initial Assessment

Use the following steps to begin isolating the problem.

Attempt Power Up

Assess the unit's overall condition by performing the following steps.

1. Disconnect the AC Power cord (if connected).
2. Insert a fully charged battery into the unit.
3. If the unit is used with a Data Card, insert a new, empty M3510A Data Card into the unit.
4. Attempt to power up the unit by turning the Energy Select Switch to either **Manual On** or **AED ON**.

Evaluate the Response

The unit will respond in one of the following 3 ways:

No response

IF The unit emits no sounds, and no changes are visible on the display.

THEN Troubleshoot further using Table 3-1 on page 3-8. ("Unit Unresponsive").

Minimal response

IF Unit provides only a slight response, such as a click or chirp from the speaker, or a change in the brightness or the borders of the display.

THEN Replace the Control PCA (see "Removal and Replacement" on page 4-1).

Return to this section and begin again with "Attempt Power Up".

Powers Up

IF The unit can generate tones or voice prompts, or display text or graphics, or respond to keypresses.

THEN Proceed to "Diagnosing External Failures" on page 3-4.

IF The screen is blank except for an error message such as **Defib Failure - Cycle Power**.

THEN Proceed to "Diagnosing Internal Failures" on page 3-5.

Diagnosing External Failures

Many times, a problem will be the result of external failures such as defective cables, depleted batteries, or improper operation. Use the steps below to rule out these external failures before looking for an internal failure in the unit.

Capture the Configuration Data

Store the unit's configuration data on a Data Card or print out the current configuration, if possible. See "Configuration Mode" on page 2-10.

Print the System Log

Print out the System Log if possible, and use any error codes to help isolate the problem. See "System Log" on page 2-20.

NOTE

The M4735A log of error codes only reports the last 10 errors. If new errors are created at this stage they may overwrite the existing codes and valuable clues to the reported problem might be lost. Therefore always attempt to print the System Log before proceeding.

Rule out external components and improper use

Referring to Table 5-16 for Supplies and Accessories, make sure the unit has:

- An undamaged, fully charged M3516A battery.
- A new, dry roll of Agilent 40457C/D printer paper. Printer paper may jam if paper is wet. Also, printer may be damaged if wet paper is allowed to dry while in contact with the printer elements.
- Cables and sensors which are approved by Agilent and known to be good. Also make sure that all external cables are fully inserted in their receptacles.
- A new, empty Data Card of the correct type (M3510A). Plugging in the wrong type of card (e.g., a modem card) can cause startup failures.

To help identify problems which may be caused by external components or by improper use, refer to:

- Table 3-3 ("System Messages") and Table 3-4 ("Momentary messages").
- The individual tables describing Operational Problems associated with each function (defibrillation, ECG, etc.). See "Troubleshooting Tables" on page 3-6.

Proceed to Internal Failures

If none of the above resolves the problem, proceed to "Diagnosing Internal Failures" on page 3-5.

Diagnosing Internal Failures

The following steps will help you isolate an internal failure to a particular subassembly.

Capture the Configuration Data

If not already captured, store the unit's configuration data on a Data Card or print out the current configuration, if possible. See "Configuration Mode" on page 2-10.

Print the System Log

If not already printed, print out the System Log if possible, and use any error codes to help isolate the problem. See "System Log" on page 2-20.

NOTE

The M4735A log of error codes only reports the last 10 errors. If new errors are created at this stage they may overwrite the existing codes and valuable clues to the reported problem might be lost. Therefore always attempt to print the System Log before proceeding.

Run Self Tests

To run the Self Tests, perform the following steps:

1. Enter Diagnostic Mode. See "Diagnostic Mode" on page 2-11.
2. Run the Extended Self Test. See "Extended Self Test" on page 2-22.
3. Run the individual Diagnostic Tests that are applicable to the problem. Diagnostic Tests are described starting with "User Interface Tests" on page 2-25.

Use the Troubleshooting Tables

Use the Tables provided starting on page 3-6 to isolate the problem based on factors such as:

- Error codes reported in the System Log (Table 3-2, page 3-10).
- Extended Self Test failures (Table 3-6, page 3-17).
- Operational problems (starting with Table 3-7 on page 3-18).

Troubleshooting Tables

Tables are provided to cover the troubleshooting topics below.

General Problems	***Page***
Unit Unresponsive	3-8
Error Codes	3-10
System Messages	3-12
Momentary Messages	3-14
Audio Tones	3-16
Extended Self Test Failures	3-17

Operational Problems	***Page***
ECG Monitoring	3-18
SpO2 Monitoring	3-20
Defibrillation and Cardioversion	3-21
Pacing	3-24
Printer	3-25
Display	3-26
Audio	3-27
Keys	3-28
Battery and Charging Circuits	3-29
Data Card	3-30

Using the Tables

The tables provide both ***Possible Causes*** and ***Corrective Actions***. Use them as follows:

- The ***Possible Causes*** are arranged in order of the approximate probability of their occurrence. Investigate them in the order given.
- For each ***Possible Cause***, try the ***Corrective Actions*** listed. If the first ***Corrective Action*** does not fix the problem, try the others in the order listed.
- If none of the ***Corrective Actions*** fixes the problem, then try the next ***Possible Cause*** listed.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

General Problems

The folowing tables describe general or system-level problems. For problems pertaining to a particular operation or function, see "Operational Problems" on page 3-18.

Unit Unresponsive

Isolate the fault by following the steps in Table 3-1 below.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-1 Unit Unresponsive

Test	Result	Possible Causes	Corrective Actions
1. Connect AC Power to unit.	"AC Power' indicator turns GREEN.	Normal response.	None. Proceed to step 2.
	'AC Power' indicator stays OFF.	No power in AC outlet.	Restore power.
		Power cord defective.	Replace power cord.
		AC Power Module failure.	Replace AC Power Module.
2. Turn on Power and observe unit's response.	Unit powers up to some working state.	Main fuse open.	1. Replace Main Fuse. 2. Replace Power PCA and Main Fuse.
		Open in battery wiring.	1. Check/replace Battery PCA. 2. Check/replace wiring to Power PCA.
	Unit still unresponsive.	Short or other failure somewhere in unit.	Disconnect printer and display from Control PCA at Control PCA. Then proceed to step 3.

3. Turn on Power and observe unit's response.	Unit powers up to some working state.	Short in printer or display.	Isolate the fault by reconnecting one at a time and powering up again. Then replace the display or printer as needed.
	Unit still unresponsive.	Short or other failure somewhere in unit.	1. Replace Control PCA. 2. Replace Power PCA. 3. Replace Parameter PCA. If all above unsuccessful, return unit for bench repair.

Error Codes

The System Log provides error codes in 5 digit hexadecimal format, as shown below.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-2 Error Codes

Error Code	Possible Causes	Corrective Actions
00000 - 00400	Defib failure - charging circuits.	1. Replace Power PCA. 2. Replace Control PCA.
01000	Defib failure - biphasic processor.	1. Replace Power PCA. 2. Replace Control PCA.
02000	Leads front end failure.	1. Replace Parameter PCA. 2. Replace Control PCA.
04000	Pacer failure.	Replace Power PCA.
08000	Processor error.	Replace Control PCA.
10000 - 1FFFF	System monitor failure.	Replace Control PCA.
20000 - 2FFFF	Front end failure.	1. Replace Control PCA. 2. Replace Parameter PCA.
30000 - 3FFFF	Pacer failure.	1. Replace Power PCA. 2. Replace Control PCA.
40000 - 4FFFF	Monitor processor failure.	1. Replace Parameter PCA. 2. Replace Control PCA.
50000 - 5FFFF	SpO_2 problem.	1. Replace SpO_2 PCA. 2. Replace Parameter PCA. 3. Replace Control PCA.
60000 - 6FFFF	Advisory Failure	Replace Control PCA.
80000 - 8FFFF	IRDA failure.	1. Replace Parameter PCA. 2. Replace Control PCA.
90000 - 90002	Self Test failure - RAM/ROM or Gate Array.	Replace Control PCA.
90003	Self Test failure - Data Card circuits.	Replace Control PCA.
90004 and 90005	Self Test failure - Codec/time base.	Replace Control PCA.
90006	Self Test failure - SpO_2.	1. Replace SpO_2 PCA. 2. Replace Parameter PCA. 3. Replace Control PCA.
90007 and 90008	Self Test failure - Pacer or Defib.	1. Replace Power PCA. 2. Replace Control PCA.

Table 3-2 Error Codes

Error Code	Possible Causes	Corrective Actions
90009	Self Test failure - Front End.	1. Replace Power PCA. 2. Replace Parameter PCA. 3. Replace Control PCA.
9000A	Lithium backup battery failure.	1. Replace lithium battery. 2. Replace Control PCA.
A0000-A7FFF	Data Card failure.	1. Replace Data Card. 2. Replace Control PCA.
A8000 - AFFFF	Data Archival error.	Replace Control PCA.
B0000 - BFFFF	Audio failure.	Replace Control PCA.
F0000 - F0001	RAM/ROM failure.	Replace Control PCA.
F0002	Demo Mode failure	Replace Control PCA.
F0003	Keyscanner failure	1. Replace Keyscan PCA. 2. Replace Control PCA.
F0004	System Communication error	Replace Control PCA.

System Messages

System messages remain on the display until the specified action is taken or no longer relevant. They are intended for the end user and appear in the ***User's Guide***. A subset of the available messages is duplicated here for the reference of the service person.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-3 System Messages

Message	Description	Corrective Action
Configuration Lost	The configuration is reset to the default settings.	1. Reconfigure the M4735A. 2. If problem reoccurs, service the unit. See "Troubleshooting" on page 3-1 and Table 3-6 on page 3-17.
Data Card Disabled	The PC card is not in use because it is full, incompatible, absent, removed during the incident, or inserted after the M4735A was turned on.	If possible, turn the M4735A off for more than 2 minutes, then insert a new, empty, M3510A Data Card and turn the device on.
ECG Fault	The ECG data acquisition system failed and data is unavailable from the 3- or 5-lead monitoring electrodes.	Service the unit. See "Troubleshooting" on page 3-1 and Table 3-7 on page 3-18.
Monitor Failure - Cycle Power	An error has occurred in the monitoring subsystem.	Turn power off, then on. If message reappears, service the unit. See "Troubleshooting" on page 3-1.
Low Battery	The battery has sufficient capacity remaining to provide only about ten minutes of monitoring time and six shocks before the M4735A shuts off.	Replace the battery with a fully charged M3516A battery.
Leads Off	The monitoring electrodes are not applied or are not making proper contact with the patient. The ECG cable is not connected. The internal cable from the ECG connector to the Parameter PCA is disconnected Failure on the Parameter PCA.	Check that the monitoring electrodes are properly applied. Check that the ECG cable is properly connected. Check the internal cable. Replace the Parameter PCA.
No Pads	The multifunction defibrillation electrode pads are not properly connected to the M4735A.	Check the pads cable connection.
No Paddles	In Manual Mode, no therapy cable is connected to the instrument.	Connect the cable.
Pads Cable Off	The pads cable is not connected to the defibrillator. Failure on Power PCA.	Check that the pads cable connector is locked in place. Replace Power PCA.

Message	Description	Corrective Action
Pads Off	The pads are not making proper contact with the patient. Failure on Power PCA.	Make sure the pads are properly applied to the patient. Replace Power PCA.
Defib Failure - Cycle Power	An error has occurred in the defibrillator subsystem.	Turn power off, then on. If message reappears, service the unit. See "Troubleshooting" on page 3-1 and Table 3-9 on page 3-17.
50J Maximum	When using internal paddles, the maximum energy delivered is limited to 50J.	Select a lower energy.
Pacer Failure	The pacing system is not functioning.	Service the unit. See "Troubleshooting" on page 3-1 and Table 3-10 on page 3-24.
Pacer Output Low	The pacer is delivering less current to the patient than specified in the output current setting.	Check the pads are applied properly (patient impedance is high).
System Failure Service Unit	A serious malfunction has occurred.	Service the unit. See "Troubleshooting" on page 3-1.
SpO2 Cable Off	The SpO_2 cable is not connected to the device.	Attach the SpO_2 cable to the M4735A.
SpO2 Light Interf	The level of ambient light is so high that the sensor cannot obtain an SpO_2 reading, or the sensor or cable is damaged.	1. Cover the sensor with an opaque material. 2. Check the sensor and cable for damage; try another sensor and cable.
Non Pulsatile	The patient's pulse is absent or too weak to be detected.	1. Check that the sensor is applied properly. 2. Make sure the sensor site has a pulse. 3. Relocate the sensor to a site with improved circulation. 4. Try another sensor.
SpO2 Low Signal	SpO_2 signal is too low to give an accurate reading.	1. Check the sensor is applied properly. 2. Try another sensor type.
SpO2 Noisy Signal	Excessive patient movement, electrical interference, or optical interference is present.	1. Minimize patient movement or apply the sensor to a site with less movement. 2. Secure the sensor cable loosely to the patient. 3. Reduce sources of electrical or optical interference.
SpO2 Sensor Fail	The SpO_2 cable is not connected to the device; or the cable or sensor are broken.	1. Attach the cable to the M4735A. 2. Replace cable and/or sensor.
SpO2 Failure	A failure has occurred in the SpO_2 circuitry.	Turn power off, then on. If message reappears, service unit. See "Troubleshooting" on page 3-1.
System Failure - Cycle Power	A serious error has occurred.	Turn power off, then on. If message reappears, service unit. See "Troubleshooting" on page 3-1.

Momentary Messages

Momentary messages are temporary and only appear on the display for a few seconds. They are intended for the end user and appear in the ***User's Guide***. A subset of the available messages is duplicated here for the reference of the service person.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-4 Momentary messages

Message	Possible Cause	Corrective Action
Attach Leads	The user attempted to begin pacing in Demand Mode without ECG leads attached to the patient.	Attach leads to patient.
Use Leads	With paddles connected and selected as the ECG input, the user attempted to activate Synchronized Cardioversion. With no leads connected, the user connected paddles and selected them as the ECG input, then connected the leads.	Use leads for ECG. Use leads for ECG.
Attach Pads	The multifunction defib electrode pads are not making proper contact with the patient.	1. Check the pads are applied to the patient, as directed on the package. 2. Replace pads if the prompt continues.
Attach Paddles	The user attempted to charge the defib in Manual Mode with no paddles connected.	Connect paddles.
Defib Disarmed	The defib is disarmed and no energy is available, due to one of the following: • The pads connection is compromised. • The mode is changed from Manual to AED while the defibrillator is charged. • **SHOCK** is not pressed within 30 seconds of the defibrillator being charged. • **DISARM** is pressed.	 • Check the pads are applied to the patient properly. • If a shock is indicated, deliver the shock before changing modes. • To deliver a shock, press **SHOCK** within 30 seconds of the defibrillator being charged. • None.
No Shock Delivered	Patient impedance is too high or too low.	1. Make sure pads are applied properly. 2. Replace the pads. 3. Replace the pads cable.
Check Printer	Printer paper is absent or jammed; the printer door is not closed properly.	1. Reload printer paper. 2. Make sure the door is closed properly.
Data Card Full	No data is being recorded on the Data Card, due to one of the following: • The incident is more than 2 hours in duration, causing the Data Card to fill.	 • None. A new Data Card can not be inserted during an incident.

Message	Possible Cause	Corrective Action
	• An empty Data Card was not inserted for the incident; the Data Card filled sooner.	• Use one empty Data Card per incident/ patient to decrease the chance of the card filling.
Data Card Interrupted	No data is being recorded on the Data Card, because the Data Card was removed during an incident.	Remove card, turn power off, insert card, turn power on.
Data Card Not In Service	No data is being recorded on the Data Card, because the Data Card was inserted while the M4735A was on.	None. A Data Card must be inserted prior to turning the M4735A on for the current patient.
Incompatible Data Card	No data is being recorded on the Data Card, because a Data Card other than the M3510A is inserted.	Use only M3510A Data Cards.
No Data Card Present	A Data Card is not in the M4735A.	Turn the M4735A off and insert a Data Card prior to the first event for the patient.
Key Inactive	The key pressed is currently inactive (i.e. Pacer is inactive in AED Mode).	Use the appropriate mode for the key.
Stop Pacer	Mode is pressed while pacing pulses are being delivered.	Stop pacing before changing the pacing mode.

Audio Tones

The M4735A emits tones to alert you to its status.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-5 Audio Tones

Tone	Meaning	Suggested Action
At power on, a low tone of approx. 1 second followed by a series of higher pitched, short tones.	Normal power on sequence.	None needed.
At power on, a continuous beep of about 7 seconds.	System failure - processors not communicating.	Turn power off, then on. If problem reoccurs, replace Control PCA.
At any time, a repeating tone that alternates between two frequencies.	The unit emits this tone beginning 1 minute before shutdown due to low battery charge.	1. Connect an AC Power Cord or replace the battery with one that is fully charged. 2. Replace the AC Power Cord. 3. Service the unit. See "Trouble-shooting" on page 3-1.

Extended Self Test Failures

Should the unit report a **FAIL** in the Extended Self Test, resolve it using the solutions below.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-6 Extended Self Test Failures

Failure	Possible Cause	Suggested Solution
RAM **ROM** **System** **CODEC** **IRDA** **Timebase**	Failure on Control PCA.	Replace Control PCA.
System FAIL 10	Lithium backup battery failure.	Replace lithium battery.
Data Card	Data Card full, or incompatible, or defective. Failure on Control PCA.	Replace Data Card with new, empty M3510A. Replace Control PCA.
Pacer **Defib**	Failure on Power PCA. Failure on Control PCA.	Replace Power PCA. Replace Control PCA.
FE	Failure on Control PCA. Failure on Power PCA. Failure on Parameter PCA.	Replace Control PCA. Replace Power PCA. Replace Parameter PCA.
SpO2	Failure on SpO_2 PCA. Failure on Control PCA.	Replace SpO_2 PCA. Replace Control PCA.

Operational Problems

These tables describe problems that may arise with specific functions or operations while using the M4735A.

ECG Monitoring

The following table covers problems that might arise while monitoring ECG.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-7 Operational Problems - ECG Monitoring (Pads or Leads)

Symptom	Possible Cause	Suggested Solution
Noisy trace - constant noise on the baseline.	Incorrect configuration - power line frequency (50 or 60 Hz) or Filter settings.	Check/change configuration as needed.
	Nearby source of constant interference.	Try moving cable/leads; try relocating unit.
	Failure in ECG front end.	Pads: Replace Power PCA. Leads: Replace Parameter PCA.
	Failure in signal processing circuits.	Replace Control PCA.
Noisy trace - intermittent bursts of noise or random spikes.	Nearby source of time-varying interference, such as radio transmitter (paging, walkie-talkies) or X-Ray system.	Try moving cable/leads; try relocating unit.
	Failure in ECG front end.	Pads: Replace Power PCA. Leads: Replace Parameter PCA.
	Failure in signal processing circuits.	Replace Control PCA.
Noisy trace - low frequency, periodic.	More than one instrument connected to the patient and active.	Only have one active instrument on the patient at a time.
Flat line - no waveform, no **Leads Off** or **Pads Off** message.	Short in internal ECG wiring or front end.	Pads: 1. Replace Power PCA. 2. Replace Patient Connector + its internal cable. Leads: 1. Replace Parameter PCA. 2. Replace ECG connector + internal ECG cable.
	Failure in signal processing circuits.	Replace Control PCA.

Table 3-7 Operational Problems - ECG Monitoring (Pads or Leads)

Symptom	Possible Cause	Suggested Solution
Leads Off message even though ECG cable has been replaced and is properly connected to the simulator.	Open in internal Leads ECG wiring or front end, due to:	
	Cable from ECG Connector to Parameter PCA has bad connection.	Reconnect cable properly. See "Servicing Notes" on page 4-1.
	Defective ECG Connector or cable to Parameter PCA.	Replace ECG Connector.
	Defective Parameter PCA	Replace Parameter PCA.
Pads Off message even though pads cable has been replaced and is properly connected to the simulator.	Open in internal Pads ECG wiring or front end, due to:	
	Cable from Patient Connector to Power PCA has bad connection.	Reconnect cable properly. See "Servicing Notes" on page 4-1.
	Defective Patient Connector or cable to Power PCA.	Replace Patient Connector + its internal cable.
	Defective Power PCA.	Replace Power PCA.
Trace distorted.	Failure in ECG front end.	Pads: Replace Power PCA. Leads: Replace Parameter PCA.
	Failure in signal processing circuits.	Replace Control PCA.
One or more ECG controls don't respond (e.g., select lead or ECG size).	Failure in keypress detection/processing.	1. Replace Control PCA. 2. Replace Parameter PCA.
	Failure in keys/connections.	Replace Top Case Assembly.
Poor Leads ECG signal quality.	The monitoring electrodes are not making proper contact with the patient.	Check that the monitoring electrodes are properly applied. If necessary, prepare the patient's skin and apply new electrodes.
	The monitoring electrodes are outdated or dried-out.	Check the date code on the electrodes. Do not open the electrode package until immediately prior to use.
	Radio frequency interference (RFI) is causing artifact.	Relocate or turn off equipment that may be causing RFI.

Table 3-7 Operational Problems - ECG Monitoring (Pads or Leads)

Symptom	Possible Cause	Suggested Solution
Poor Paddles/Pads ECG signal quality.	The paddles or multifunction pads are not making proper contact with the patient.	Check that the paddles or pads are properly applied. If necessary, prepare the patient's skin and reapply (or apply new pads).
	The multifunction pads are outdated or dried-out.	Check the date code on the pads. Do not open the pads package until immediately prior to use.
	Radio frequency interference (RFI) is causing artifact.	Relocate or turn off equipment that may be causing RFI.
QRS beeper inaudible or beeps do not occur with each QRS complex.	The QRS beeper is configured to **Off**.	Configure the QRS beeper to **On**.
	The volume is set too low.	Adjust the volume.
	The amplitude of the QRS complex is too small to detect.	Adjust the size of the ECG.
Fails ECG Test in Diagnostic Mode.	Failure in Pads ECG front end or signal processing.	1. Replace Power PCA. 2. Replace Control PCA.
	Failure in Leads ECG front end or signal processing.	1. Replace Control PCA. 2. Replace Parameter PCA.

SpO_2 Monitoring

The following table covers problems that might arise while monitoring SpO_2.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-8 Operational Problems - SpO_2 Monitoring

Symptom	Possible Causes	Suggested solution
No response - no value on screen, no pleth bar.	Bad internal connection.	Carefully reseat flex cables between SpO_2 connector and SpO_2 PCA, and between SpO_2 PCA and Parameter PCA. See "Servicing Notes" on page 4-1.
	SpO_2 PCA failure.	Replace SpO_2 PCA.
	Control PCA failure.	Replace Control PCA.
	Parameter PCA failure.	Replace Parameter PCA
Reads obviously wrong value.	Same as above.	Same as above.
Noisy/intermittent signal	Same as above.	Same as above.

Defibrillation and Cardioversion

The following table covers problems that might arise while defibrillating or delivering synchronized cardioversion.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-9 Operational Problems - Defibrillation and Synchronized Cardioversion

Message or Symptom	Possible Causes	Suggested solution
Won't charge in Manual Mode.	• Pads connector or internal wiring failure. • Power PCA failure. • Control PCA failure. • Parameter PCA failure. • **CHARGE** key failure.	Diagnose as follows: 1. Try AED Mode. • Charges OK: Go to step 3. • Still not charge: Go to step 2. 2. Verify Pads Off and Cable Off detection by unplugging pads, cable. • Detects both OK: Go to step 3. • Either Pads Off or Cable Off fail: replace 1) Pads connector 2) Power PCA. 3. In Diagnostic Mode, run Controls Test and test **CHARGE** key. • Key tests OK: Replace Control PCA. • Key not OK: Replace 1) Keyscan PCA 2) Bezel Assembly 3) Control PCA.
Won't charge in AED Mode.	• Pads connector or internal wiring failure. • Power PCA failure. • Control PCA failure. • Parameter PCA failure. • **CHARGE** key failure.	Diagnose as follows: 1. Try Manual Mode • Charges OK: Go to step 3. • Still not charge: Go to step 2. 2. Verify Pads Off and Cable Off detection by unplugging pads, cable. • Detects OK: Go to step 3. • Either Pads Off or Cable Off fail: replace 1) Pads connector 2) Power PCA. 3. In Diagnostic Mode, run Controls Test and test **CHARGE** key. • Key tests OK: Replace Control PCA. • Key not OK: Replace 1) Keyscan PCA 2) Bezel Assembly 3) Control PCA.

Table 3-9 Operational Problems - Defibrillation and Synchronized Cardioversion

Message or Symptom	Possible Causes	Suggested solution
Won't discharge.	• Control PCA failure. • Parameter PCA failure. • **SHOCK** key failure.	Diagnose as follows: 1. In Diagnostic Mode, run Controls Test and test **SHOCK** key. • Key tests OK: Replace Control PCA. • Key not OK: Replace 1) Keyscan PCA 2) Bezel Assembly 3) Control PCA.
Charges, but disarms when press **Shock**.	Patient impedance sensed as too high or too low during energy delivery due to: • Pads losing contact with patient. • Pads failure. • Pads cable failure. Power PCA failure. Control PCA failure.	Replace paddles, or pads and pads cable. Replace Power PCA Replace Control PCA
Charges, but disarms spontaneously.	1. Unit sensed **Pads Off** or **Cable Off** due to: • Pads losing contact with patient. • Pads failure. • Pads cable failure. • Power PCA failure. • Control PCA failure. • Parameter PCA failure. 2. **DISARM** key failure (intermittent)	Replace paddles, or pads and pads cable. Diagnose further as follows: In Diagnostic Mode, run Controls Test and test **DISARM** key. • Key tests OK: Replace 1) Power PCA 2) Control PCA. • Key not OK: Replace 1) Keyscan PCA 2) Bezel Assembly 3) Control PCA.
Charges slowly - about 4-5 sec. instead of 2-3 sec.	Battery too old or not fully charged. Unit senses unsupported battery due to: • Unsupported battery in use • Battery PCA failure. • Power PCA failure. • Control PCA failure.	Replace with new, fully charged battery. Also run Battery Capacity Test on suspect battery (see page 2-40). Use only supported battery (M3516A/M5516A). Diagnose further as follows: In Diagnostic Mode, start Battery Capacity Test (see page 2-40). • "**Unsupported battery**" on display: Stop test. Replace 1) Battery PCA 2) Power PCA 3) Control PCA. • No message on display: Stop test. Replace 1) Power PCA 2) Control PCA.

Table 3-9 Operational Problems - Defibrillation and Synchronized Cardioversion

Message or Symptom	Possible Causes	Suggested solution
Won't discharge.	• Control PCA failure. • Parameter PCA failure. • **SHOCK** key failure.	Diagnose as follows: 1. In Diagnostic Mode, run Controls Test and test **SHOCK** key. • Key tests OK: Replace Control PCA. • Key not OK: Replace 1) Keyscan PCA 2) Bezel Assembly 3) Control PCA.
Charges, but disarms when press **Shock**.	Patient impedance sensed as too high or too low during energy delivery due to: • Pads losing contact with patient. • Pads failure. • Pads cable failure. Power PCA failure. Control PCA failure.	Replace paddles, or pads and pads cable. Replace Power PCA Replace Control PCA
Charges, but disarms spontaneously.	1. Unit sensed **Pads Off** or **Cable Off** due to: • Pads losing contact with patient. • Pads failure. • Pads cable failure. • Power PCA failure. • Control PCA failure. • Parameter PCA failure. 2. **DISARM** key failure (intermittent)	Replace paddles, or pads and pads cable. Diagnose further as follows: In Diagnostic Mode, run Controls Test and test **DISARM** key. • Key tests OK: Replace 1) Power PCA 2) Control PCA. • Key not OK: Replace 1) Keyscan PCA 2) Bezel Assembly 3) Control PCA.
Charges slowly - about 4-5 sec. instead of 2-3 sec.	Battery too old or not fully charged. Unit senses unsupported battery due to: • Unsupported battery in use • Battery PCA failure. • Power PCA failure. • Control PCA failure.	Replace with new, fully charged battery. Also run Battery Capacity Test on suspect battery (see page 2-40). Use only supported battery (M3516A/M5516A). Diagnose further as follows: In Diagnostic Mode, start Battery Capacity Test (see page 2-40). • "**Unsupported battery**" on display: Stop test. Replace 1) Battery PCA 2) Power PCA 3) Control PCA. • No message on display: Stop test. Replace 1) Power PCA 2) Control PCA.

Table 3-9 Operational Problems - Defibrillation and Synchronized Cardioversion

Message or Symptom	Possible Causes	Suggested solution
Doesn't deliver correct energy into Defibrillator Analyzer or delivers no energy at all. (Should also get message - **No shock delivered** or **Defib failure**.)	Control PCA failure. Power PCA failure.	Replace Control PCA. Replace Power PCA.
Doesn't measure its own delivered energy correctly.	Power PCA failure. Control PCA failure.	Replace Power PCA. Replace Control PCA.
Not synchronizing even though ECG waveform OK on display.	Control PCA failure.	Replace Control PCA.
Fails **Defib Meas** Test in Diagnostic Mode (other then symptoms above).	Power PCA failure. Control PCA failure.	Replace Power PCA. Replace Control PCA.

Pacing

The following table covers problems that might arise while performing external pacing.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-10 Operational Problems - Pacing

Message or Symptom	Possible Causes	Suggested solution
Doesn't deliver correct current into Pacer Tester or delivers no current at all.	Control PCA failure. Power PCA failure.	Replace Control PCA. Replace Power PCA.
Doesn't measure its own delivered current correctly.	Power PCA failure. Control PCA failure.	Replace Power PCA. Replace Control PCA.
Doesn't pace at correct rate.	Control PCA failure.	Replace Control PCA.
Pacer hardware not installed. message even though Pacer is present.	Bad connections - Manual Keypad flex circuits to Keyscan PCA.	Reconnect flex circuits properly. See "Servicing Notes" on page 4-1.

Printer

The following table covers problems that might arise while printing.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Also check for damage to the printer ribbon cable where the ribbon is captured in the connectors.

Table 3-11 Operational Problems - Printer

Symptom	Possible Causes	Suggested solution
Paper won't move.	Paper improperly loaded or jammed, or paper is wet. Printer failure.	Reload paper or clear jam. If paper is wet, replace with fresh dry roll. Replace printer.
Paper moves then stops.	Door improperly latched. Paper improperly loaded or jammed.	Check door latch. Reload paper or clear jam.
Paper moves but printing is faint or absent.	Door improperly latched. Dirty printhead. Printer failure. Control PCA failure.	Check door latch. Clean printhead. Replace printer. Replace Control PCA.
Paper moves but print quality poor or some dots missing.	Dirty printhead. Printer failure.	Clean printhead. See"Cleaning the Printer Printhead" on page 4-5. Replace printer.
Loud buzzing or grinding noise.	Door improperly latched.	Check door latch.
Waveforms or text distorted even though they look OK on display.	Printer failure. Control PCA failure.	Replace Printer. Replace Control PCA.
Black line running along paper.	Dots (printhead elements) stuck on due to: Printer failure. Control PCA failure.	 Replace Printer. Replace Control PCA.

Table 3-11 Operational Problems - Printer

Symptom	Possible Causes	Suggested solution
White line running along paper.	Dirt on printhead.	Clean printhead. See "Cleaning the Printer Printhead" on page 4-5.
	Dots (printhead elements) stuck off due to:	
	Printer failure.	Replace Printer.
	Control PCA failure.	Replace Control PCA.
Fails Printer Test in Diagnostic Mode (other then symptoms above).	Printer failure.	Replace Printer.
	Control PCA failure.	Replace Control PCA.

Display

The following table covers problems that might arise with the display.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-12 Operational Problems - Display

Symptom	Possible Causes	Suggested solution
No response - all light or all dark.	Control PCA failure.	Replace Control PCA.
	Display failure.	Replace Display.
Fails Display Test in Diagnostic Mode (display problem other then symptoms above).	Display failure.	Replace Display.
	Control PCA failure.	Replace Control PCA.
Fails Display Test in Diagnostic Mode (indicator LEDs).	Control PCA failure.	Replace Control PCA.
	Main or Pacer Keypad failure.	Replace Main or Pacer Keypad.

Audio

The following table covers problems that might arise with the audio tones or voice prompts.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-13 Operational Problems - Audio Tones/Voice Prompts

Symptom	Possible Causes	Suggested solution
No audio at all.	Speaker failure.	Replace Speaker Assembly.
	Control PCA failure.	Replace Control PCA.
Audio is distorted.	Damage to speaker label.	Replace speaker label.
	Speaker failure.	Replace Speaker Assembly.
	Control PCA failure.	Replace Control PCA.
Buzzing noise when audio active.	Damage to speaker label.	Replace speaker label.
	Debris between speaker and speaker label.	Remove speaker label, clean out debris, install new speaker label.
	Speaker hardware loose.	Tighten hardware as needed.
	Speaker failure.	Replace Speaker Assembly.
	Control PCA failure.	Replace Control PCA.
Tones present but no voice prompt (in AED Mode).	Control PCA failure.	Replace Control PCA.
Voice prompt present but no tones.	Control PCA failure.	Replace Control PCA.

Keys

The following table covers problems that might arise with the keypads.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-14 Operational Problems - Keys

Symptom	Possible Causes	Suggested solution
One of the keys doesn't respond.	• Key failure. • Keyscan PCA failure. • Control PCA failure.	Diagnose as follows: In Diagnostic Mode, run Controls test and identify all unresponsive keys. • Some keys don't respond: Replace 1) Keyscan PCA 2) Control PCA 3) Bezel Assembly. • All keys don't respond: Replace 1) Keyscan PCA 2) Control PCA.
More than one of the keys, or all of the keys, don't respond.	• Keyscan PCA failure. • Control PCA failure • Keypanel failure	

Battery and Charging Circuits

The following tables cover problems that might arise with the Battery or the unit's battery charging circuits.

NOTE

Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-15 Operational Problems - Battery, Charging Circuits

Symptom	Possible Causes	Suggested solution
Low battery life (depletes quickly in use).	Very frequent use - not charging long enough between uses.	Charge fully between uses. Use spare batteries and adapters as needed to allow complete charging.
	Battery failure.	Run Battery Capacity Test (see "Battery Capacity Test" on page 2-40). If battery fails test, replace battery.
	AC Power Module failure.	Replace AC Power Module.
	Failure on Control PCA, Power PCA, or Battery PCA.	Replace 1) Control PCA 2) Power PCA 3) Battery PCA.
Fails Battery Capacity Test	Battery old, worn out, or failed.	Replace battery.
	Failure on Control PCA.	$Replace Control PCA.

Table 3-16 Power Indicator Matrix

INDICATORS		SYSTEM STATE			MEANING
AC POWER	BATT CHARGING	Connected to AC Mains?	Battery in Place?	Unit Power ON ?	
G = GREEN OR = ORANGE/AMBER		Y = YES N = NO --- = don't care			
OFF	OFF	N	---	---	Normal
G	OFF	Y	N	---	Normal
G	OR	Y	Y	---	Battery is charging.
G	G	Y	Y	---	Battery 90% charged.

Data Card

The following table covers problems that might arise with the Data Card.

NOTE Before replacing any parts, check to see if the cables and flex circuits are properly connected. See "Servicing Notes" on page 4-1.

Table 3-17 Operational Problems -Data Card

Symptom	Possible Cause	Corrective Action
Data card is not recognized when plugged in.	Unit power is already on. Card is only recognized during power-up sequence. Card is full or not a supported type.	Turn power off for 2 minutes, then on again. Use a new, empty M3510A Data Card.
Data on the card corrupted.	The card was removed while the unit power on.	Only remove card after power is turned off. Delete corrupted files using the CodeRunner Web Data Management System.
Fails Data Card Test in Diagnostic Mode	Card is full or not a supported type. Failure on Control PCA.	Use a new, empty M3510A Data Card. Replace Control PCA.

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Calling for Service

For telephone assistance, call the Agilent Response Center nearest to you, or visit our website at: www.agilent.com/healthcare .

United States of America

Medical Response Center	Tel: (800) 548-8833

Canada

Eastern Region	Central & Western Regions
Tel: (800) 361-9790	Tel: (800) 268-1221

Other International Areas

Australia	France
Tel: 131147	Tel: 0803 35 34 33

Germany	Italy
Tel: 0130-4730	Tel: 0292 122999

Netherlands	United Kingdom
Tel: (0) 20-547-6333	Tel: 44-344-36633

Belgium	
Tel: 32 2 778 35 31	

Equipment Information

Use the table below to summarize information you'll need when calling for service.

Model Number	Serial Number	Location (Dept.)

Biomedical Warranty or Support Contract Number

_____

4 Removal and Replacement

Overview

This chapter provides procedures for removing and replacing subassemblies of the M4735A. Most of the subassemblies described are available as replacement parts. However, some of those described are **not** available, and are included because they need to be removed to service other subassemblies. For a complete listing of which subassemblies are available as replacement parts, see "Replacement Parts" beginning on page 5-1.

Chapter Contents

The major sections of this chapter are as follows:

Section	*Page*
Servicing Notes	4-1
External Assemblies	4-4
Opening the Case	4-24
Internal Assemblies - Top Case	4-33
Internal Assemblies - Bottom Case	4-79
Closing the Case	4-99

Servicing Notes

Following are some important points to keep in mind whenever servicing the M4735A.

Key Components

Replacement assemblies marked with an asterisk (" * ") in the Replacement Parts tables contain one or more Key Components. Key Components require detailed tracking, by recording the key component part number and either the key component's date code or its serial number. This data must be recorded for both the failed assembly and the replacement assembly.

Agilent Technologies service personnel must record this information on the Customer Service Order (CSO).

The Key Components that are part of the replacement assemblies are listed in Table 5-17 on page 5-21.

Removal, Handling, and Replacement

The following sections give details of how to successfully work with the internal assemblies of the M4735A.

Flex Circuit Connections

In order for flex circuit connections to function properly, they must be disconnected and reconnected as follows:

- Always unlatch the PCA-mounted connector before removing the flex circuit, and hold the latch open while reinserting the flex circuit into the connector.
- When reconnecting, align the flex circuit carefully in its receptacle, making sure it is both centered from side to side in the connector, and oriented at 90 degrees to the connector.
- Be sure the flex circuit is fully seated in the connector and the connector is properly latched.

Flex Circuit Handling

The flex circuits are delicate and can be damaged by improper handling:

- Do not bend sharply.
- Do not scrape the contact surface against other parts.
- Handle the flex with bent tip needle nose pliers whose jaws are covered with a soft material (such as plastic tubing or tape).

Internal Connections

Whenever troubleshooting indicates a particular PCA may be at fault, it is always good practice to check all the connections to that PCA and retest before replacing the PCA.

Cable and Assembly Placement

How the wires and cables are routed and dressed inside the chassis plays an important role in two areas: in preventing long term wear problems, and in reducing electromagnetic and radio frequency interference emitted by the defibrillator.

- When you disassemble any part of the defibrillator, pay special attention to how cables and wires are routed.
- When you reassemble the defibrillator, be sure to route and dress all cables and wires as they were originally.
- Return all components to their original position within the case.

Instrument Reassembly

If you do not reassemble the instrument correctly, the instrument may no longer be properly sealed. This could result in water damage to the defibrillator. Be sure to maintain the water-resistant seal by:

- Replacing all gaskets in their proper locations.
- Correctly assembling all parts that mate with gaskets (making sure the gaskets are not wrinkled or pinched).
- Replacing all screws.
- Making sure that screws are not cross-threaded and that they are tightened firmly.

Tool Requirements

The following tools are needed to perform the procedures given.

- Torx T10 and T15 drivers (or Torx driver kit, Agilent part number 5181-1933). T15 driver shaft should be at least 2.25" long and less than 5/16" in diameter to reach down to recessed case screws.
- Slip-joint pliers or adjustable open-end wrench.
- Small straight bladed screwdriver.
- Straight tip needle nose pliers or tweezers.
- Bent tip needle nose pliers whose jaws are covered with a soft material (such as plastic tubing or tape).
- Fine nose wire cutters.
- Utility knife.
- High voltage discharge tool for discharging the defibrillator capacitor (Agilent part number M2475-69572).
- Clip leads (at least 2, each approx. 10-18").
- Software Support Tool (M4735-87890).

Disposal

Disposing of the M4735A

Prior to disposing of the M4735A, remove the battery. Then dispose of the device in accordance with local standards.

WARNING **Disposal of the device with the battery inserted presents a potential shock hazard.**

Disposing of the SLA Battery

The M3516A battery utilizes Sealed Lead Acid (SLA) technology. Dispose of the battery or recycle it according to local regulations for lead-containing products.

External Assemblies

This section describes how to remove and replace assemblies that are external to the sealed case. These assemblies include:

Assembly	Page
User-replaceable Parts and Accessories	4-5
Printer Assembly	4-6
Battery Cover	4-10
Main Fuse	4-14
Battery Eject Assembly	4-14
Data Card Door	4-16
Energy Select Knob	4-17
Paddle Holders	4-18
Labels	4-20
Label Descriptions	4-20
Removing and Replacing Labels	4-22

CAUTION

Be sure to work in a static safe environment. The work surface and area surrounding it must be static free. Use a static control wrist band, in conjunction with an antistatic pad which is grounded per the manufacturer's instructions.

User-replaceable Parts and Accessories

The ***User's Guide*** gives detailed instructions on replacing the following:

- Patient cables & sensors
- Battery
- Printer paper

User Maintenance

The ***User's Guide*** gives detailed instructions on maintaining and cleaning the M4735A, including:

- Operational Checks
- Battery Maintenance
- Cleaning Instructions

For the convenience of the service person, instructions on cleaning the printer printhead are duplicated here. Instructions on running the Battery Capacity Test are duplicated on page 2-40.

Cleaning the Printer Printhead

If the traces or characters in the printout are faint or vary in density (darkness), clean the printhead to remove any buildup of paper residue.

1. **Open the printer and remove the paper**

   a. Slide the printer door to the right until the paper roller pops up.

   b. Pull up on the plastic tab to remove the roll of paper.

2. **Clean the printhead**

   Clean the printhead surface (above the brush) with a cotton swab dipped in isopropyl alcohol. Take care to not leave cotton fibers behind.

3. **Replace the paper.**

4. **Close the printer door.**

Printer Assembly

The following steps describe how to remove and replace the printer assembly.

Preparation

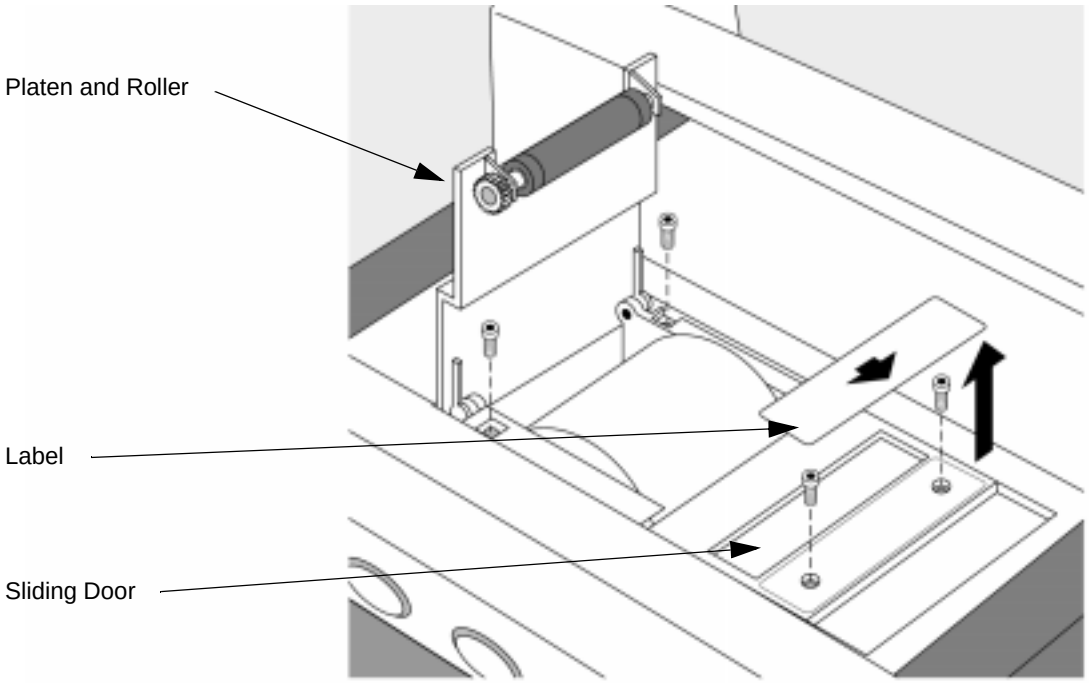
1. **Discharge the power supply capacitors.**
   a. Disconnect the AC power and remove the battery.
   b. Discharge the power supply capacitors by turning the power on. You will hear a click from the speaker.
2. **Open the printer and remove the paper**
   a. Open the printer by moving the sliding door in the direction of the arrow and lifting up the platen and roller.
   b. Pull up on the plastic tab and lift the paper out of the printer.

Removal

1. **Loosen the 2 screws under the platen.**

   Loosen the (2) T10 screws now visible on the top and bottom edges of the printer assembly at the left end. See See Figure 4-1 on page 4-7. .
2. **Remove the label and loosen the other 2 screws.**
   a. Using a utility knife, pick up one corner of the label.
   b. Peel the label up by pulling slowly and evenly on the loosened corner.
   c. Loosen the (2) T10 screws under the label.

Figure 4-1 Removing the Printer Label and Screws



3. **Remove the printer assembly.**

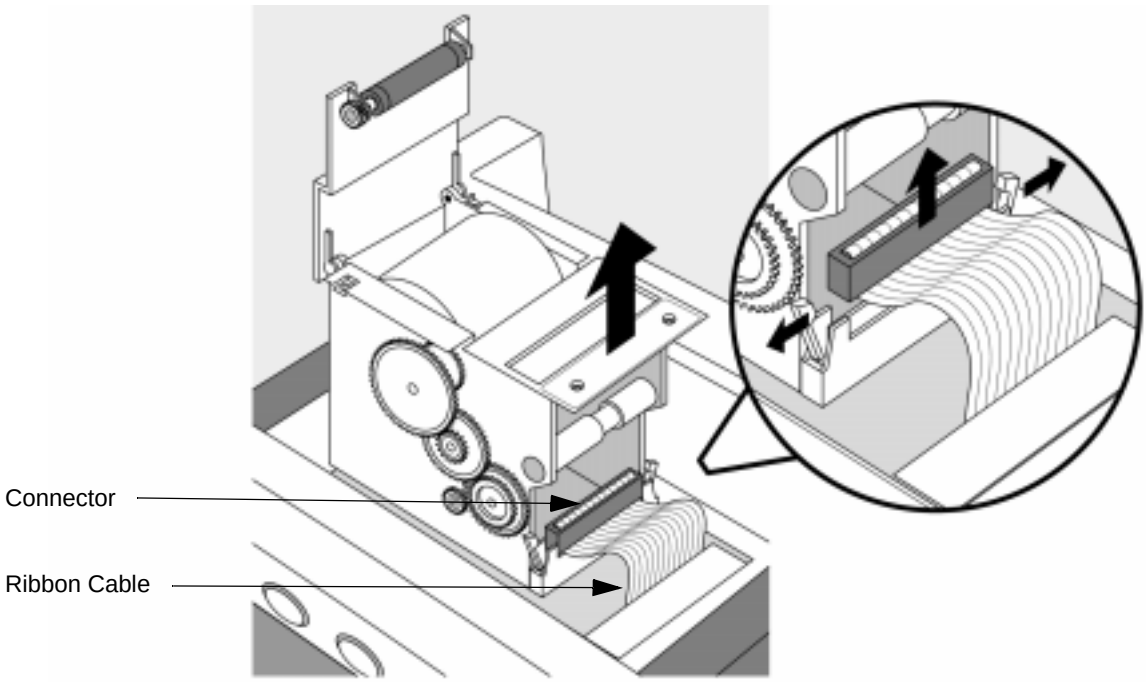
   Pull the printer straight up out of the printer bucket. See Figure 4-2 on page 4-8.

4. **Disconnect the ribbon cable.**

   Unlatch the connector latches and unplug the ribbon cable as shown in See Figure 4-2 on page 4-8.

   TIP: If you are installing a replacement printer, remove the 4 screws now. If you are moving the printer to a new Top Case Assembly, save work by leaving the screws in place.

Figure 4-2 Removing the Printer



Replacement

1. **Replace the 4 screws.**
   a. Open the paper door.
   b. Place the 4 screws in their holes in the printer. Use tweezers or fine nose pliers to replace the 2 screws under the sliding door.
2. **Reconnect the ribbon cable.**
   a. Align the ribbon connector and push it straight into the connector on the printer.
   b. Engage the 2 latches on the ends of the connector.
3. **Lower the printer straight down into the instrument.**
4. **Tighten all 4 screws.**
5. **Replace the label.**
   a. Remove any adhesive residue by rubbing the dry surface with your finger and "rolling up" the adhesive residue. Solvents are ineffective, as is scraping with a tool.
   b. Clean the surface with isopropyl alcohol. Allow it to dry.
   c. Peel the backing off the new label. Avoid touching the label adhesive.
   d. Align one edge of the label with the recess on the sliding door, then roll the label down into position.
   e. Press firmly all over the label, especially the edges, to ensure it adheres to the door.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Battery Cover

The instructions that follow describe how to remove and replace the battery cover.

Preparation

1. **Remove the battery.**
2. **Remove the paddles from their retainers.**
3. **Turn the unit over.**

   Turn the unit upside down with the handle facing you. The battery cover is at left side of the bottom surface.

Removal

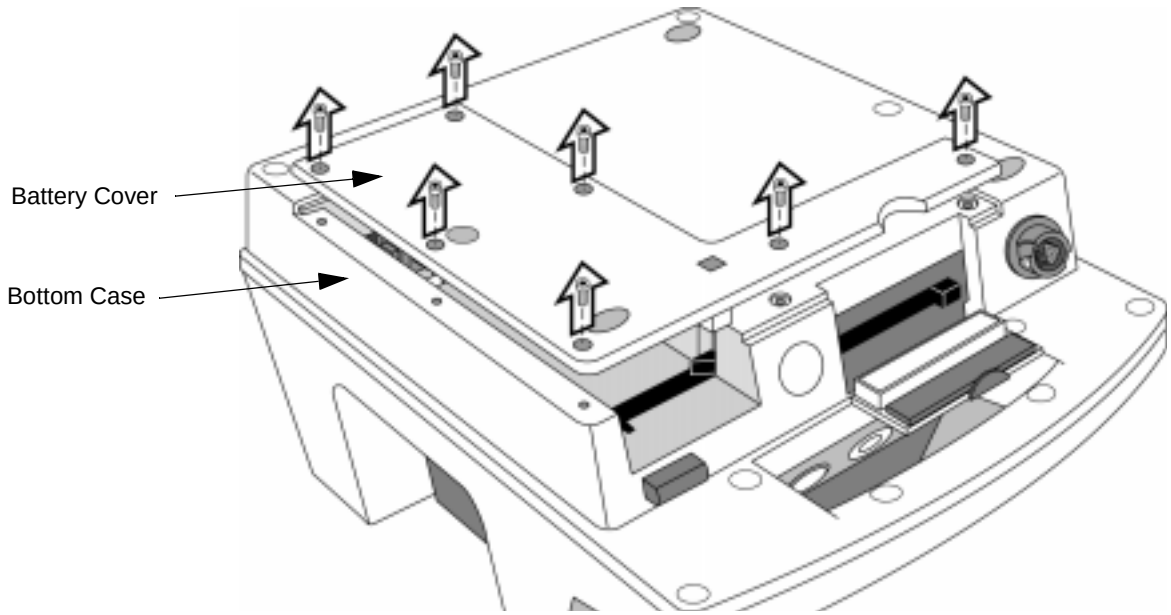
1. **Remove the battery cover.**

   Remove the 7 screws as shown in Figure 4-3.

   TIP: The screws are size-coded. Remove only the T10 screws.

2. **Lift the battery cover up.**

Figure 4-3 Removing the Battery Cover



Replacement

1. **Check the Battery PCA and the Battery Eject Spring.**

   a. Ensure the lower edge of the Battery PCA is seated in its slot in the case

   b. Check that the Battery Eject Spring is all the way at the bottom of its slot.

c. Check the orientation of the Battery Eject Spring. Correct orientation is when the spring is angled slightly toward the Battery PCA, and NOT angled up out of the battery compartment. Adjust the angle of the spring as needed by turning it while keeping it in place in its slot.

2. **Insert a battery to compress the springs and position the PCA.**

   a. Slide a battery into the battery compartment. Be sure the battery stays flat and does not push up out of position.

   b. As the battery latches into place, it will push the Battery PCA into position and compress both the Battery Eject Spring and the Battery PCA Spring.

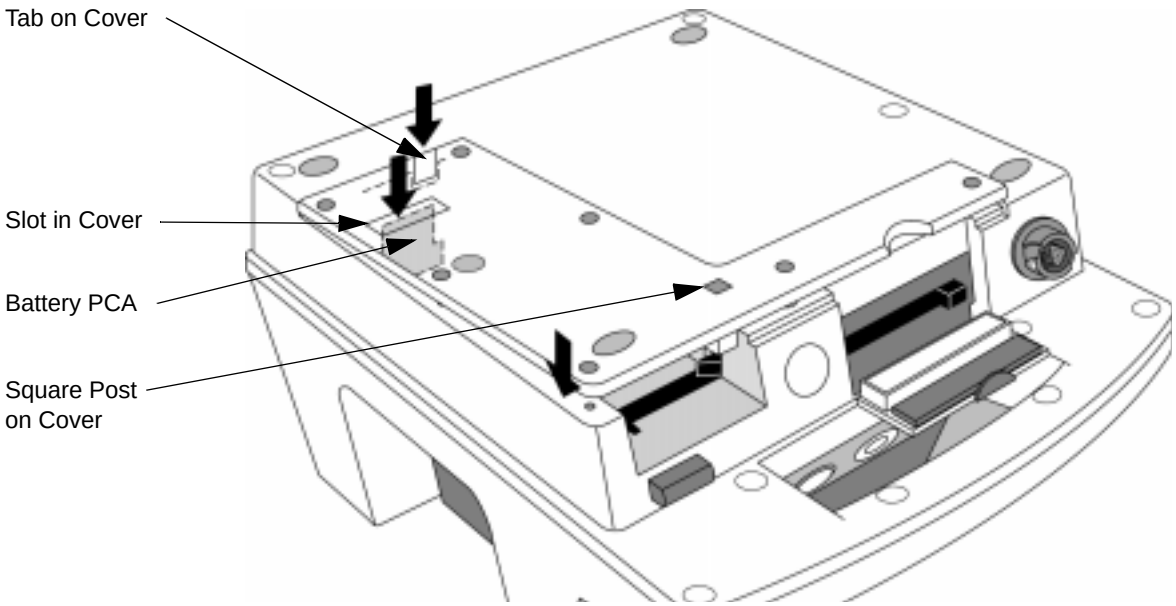
3. **Replace the Battery Cover.**

   a. While keeping the battery in place, replace the battery cover starting with the end by the battery PCA. See Figure 4-4.

   b. Insert the tab on the cover into the mating slot next to the battery spring. Then lower the cover into position, allowing the square post on the cover to mate with the recess in the case.

   c. Replace all 7 screws and tighten.

Figure 4-4 Installing the Battery Cover



After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Main Fuse

The main fuse is located on the Battery PCA, which is under the Battery Cover.

Removal

1. **Remove the Battery Cover**

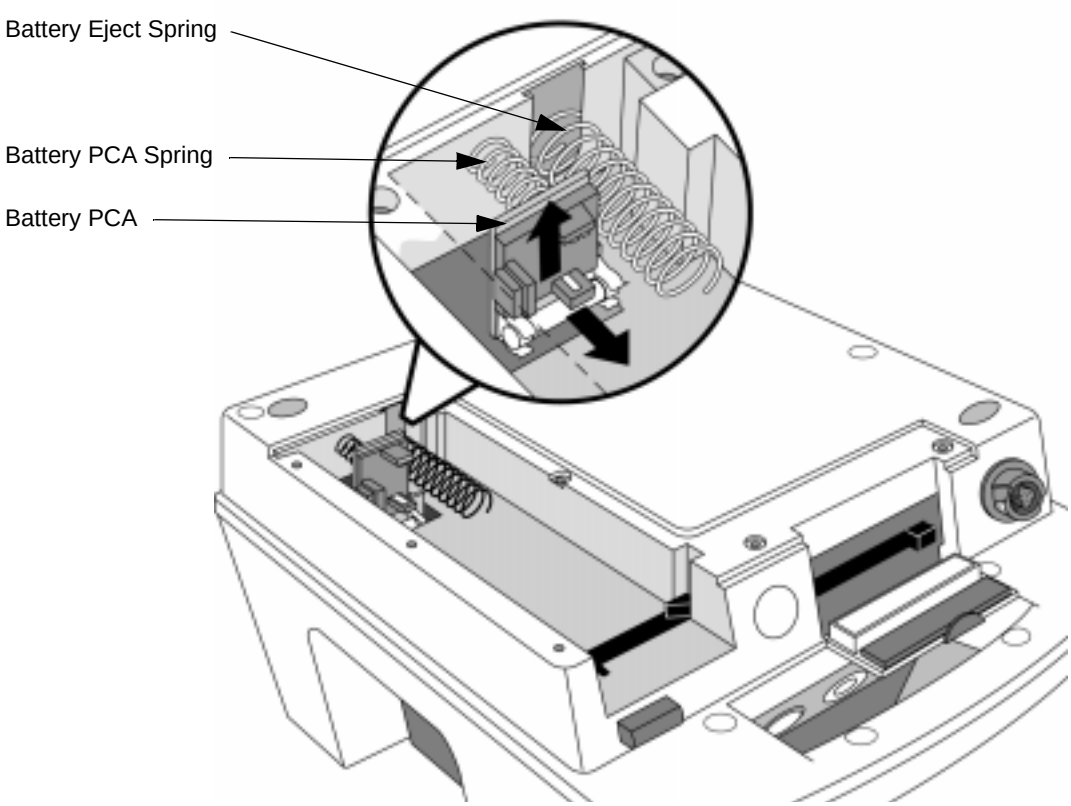
   See "Battery Cover" on page 4-10.

2. **Remove the fuse.**

   a. Pull out the Battery PCA far enough to access the fuse.

   b. Remove the fuse by pulling straight up from PCA as shown in See Figure 4-5 on page 4-12. .

Figure 4-5 Removing the Main Fuse



Replacement

1. **Snap the new fuse into position on the PCA.**
2. **Restore the Battery PCA to its original position.**

   Push the Battery PCA back into the case, being sure the lower edge of the PCA engages the slot in the bottom case.
3. **Replace the battery cover.**

   See "Battery Cover" on page 4-10.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Battery Eject Assembly

The Battery Latch engages when the battery is fully inserted in the battery compartment, and it is released by pushing the Battery Eject Button.

Removal

1. **Remove the Battery Cover**

   See "Battery Cover" on page 4-10.

2. **Remove the Battery Eject Button.**

   a. Press the Battery Eject Button all the way in and hold it in.

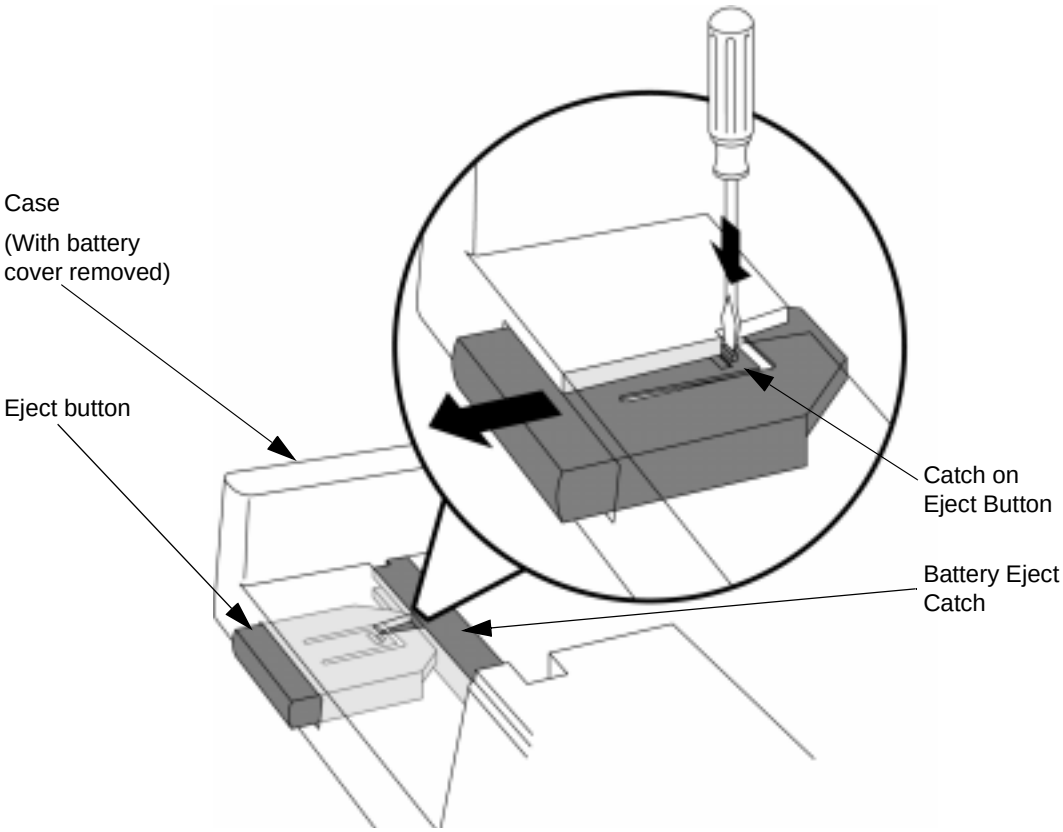
   b. Using a small flat bladed screwdriver, press in the catch on the Eject Button and slide the Eject Button out of the case. Note the orientation of the Eject Button. See Figure 4-6.

   TIP: The catch is located in the narrow slot in the bottom case that points to the eject button. See Figure 4-6.

3. **Remove the Battery Eject Catch.**

   Pull the Battery Eject Catch up out of its slot in the case. There will be a long spring (the Battery Catch Spring) inside the catch. Note the orientation of the Catch in its slot.

Figure 4-6 Battery Eject Mechanism



Replacement

1. **Install the Spring into the Catch.**

   Insert the new Battery Catch Spring into the hole in the end of the new Battery Eject Catch.

2. **Install the Battery Eject Catch.**

   Insert the new Battery Eject Catch into its open slot in the bottom case. Orient it so the spring points toward the Data Card Door and the triangular plastic catch faces up toward you through the open slot.

3. **Install the Battery Eject Button.**

   a. Insert the Battery Eject Button into its hole in the bottom case.

   b. Push the Eject Button all the way in to engage its catch and prevent it from falling back out. Check to be sure the Eject Button and Eject Catch slide freely and operate correctly.

4. **Replace the battery cover.**

   See "Battery Cover" on page 4-10.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Data Card Door

The following sections describe how to remove and replace the Data Card Door.

Removal

1. **Open the door.**

   This will expose the spring-loaded shaft on which the door pivots.

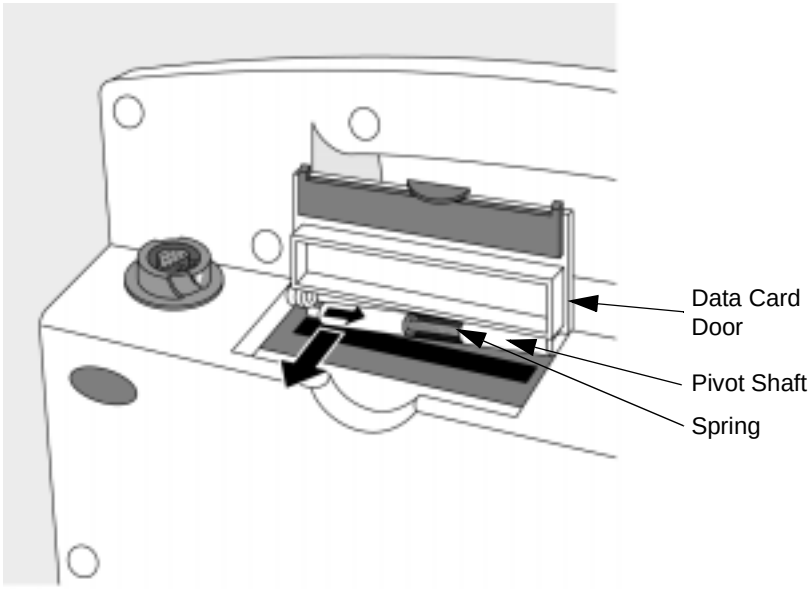
2. **Compress the shaft.**

   a. Using a small flat bladed screwdriver, catch the **left** end of the pivot shaft and slide it toward the center, compressing the spring.

   b. When the spring is compressed enough, the pivot shaft will pop easily out of its hole in the bottom case.

3. **Remove the door.**

Figure 4-7 Removing the Data Card Door



Replacement

1. **Check the mating holes.**

   Check to be sure the pivot holes in the case have not been damaged. If they have been, the Bottom Case Assembly must be replaced.

2. **Insert the door.**

   TIP: The new door comes complete with the black latch, the pivot shaft and the spring already installed in the door.

   a. Insert the **right** end of the pivot shaft into its hole in the case.

   b. Push in the **left** end to compress the spring, then slide the left end into place. Be sure the shaft snaps into position.

   c. Check to be sure the door moves freely, latches securely, and springs open when unlatched.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Energy Select Knob

The following sections describe how to remove and replace the Energy Select Knob.

Removal

Remove the Energy Select Knob.

Grasp the knob and pull straight out from the Front Bezel.

TIP: To get a better grip on the knob, try wearing rubber gloves.

Replacement

Replace the Energy Select Knob.

Push the knob onto the shaft. Be sure the knob is pressed fully into place.

Paddle Holders

The following sections describe how to remove and replace the Paddle Holders.

Preparation

Remove the paddles from the holders.

Removal

1. **Remove the Paddle Holder.**

   a. Remove the 2 T15 screws.

NOTE

These **flat head** T15 screws are different from the **pan head** T15 screws used in the rest of the unit. Keep them separate and use them only for the Paddle Holder.

   b. Slide the Paddle Holder out from under the metal clip.

2. **Remove the clip.**

   a. Remove the T10 screw.

   b. Remove the clip.

Figure 4-8 Removing the Paddle Holder

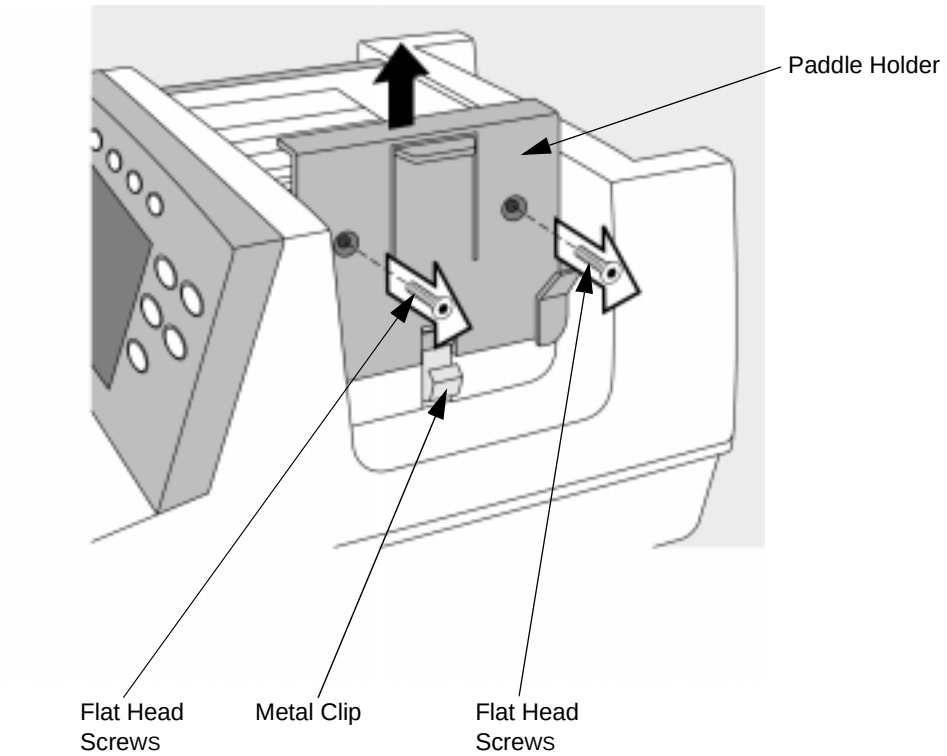
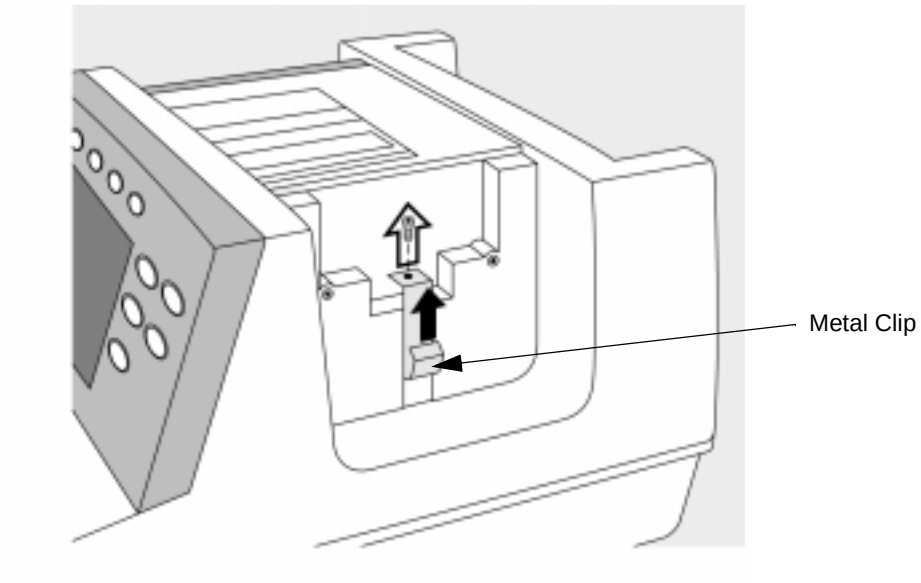


Figure 4-9 Removing the Clip



Replacement

1. **Replace the clip.**
   a. Place the clip in its slot in the case. Use the new one that came with the replacement Paddle Holder.
   b. Replace the T10 screw and tighten securely.
2. **Replace the Paddle Holder.**
   a. Slide the Paddle Holder into position under the clip.
   b. Replace the 2 T15 screws and tighten securely.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Labels

The labels used on the M4735A are divided into 4 groups: the Instruction Label Set, the Case Label Set, the Branding Label Set, and the Speaker Label. Each set of labels is one sheet containing all the labels in that set.

The labels are adhesive-backed, and replacing a label consists of peeling up the old, cleaning the surface, and sticking down the new. See "Removing and Replacing Labels" on page 4-22.

Label Descriptions

The following sections describe each of the label sets in more detail.

Instruction Label Set

The Instruction Label Set includes one label - the label above the printer giving a brief overview of device operation.

This label comes in 2 versions - for units with and without the Pacing option. Each of these versions is available in all the supported languages (see Tables 5-11 and 5-12 for part numbers).

See Figure 4-10 for locations of these labels.

Case Label Set

The Case Label Set includes the following labels:

- ECG/SpO_2 Connector label (includes Warnings and Notices)
- Data Card Eject label
- Patient Connector label
- Blank label (under hole plug next to Data Card)
- Charge Battery label (on bottom of case)
- Printer label (arrow on printer sliding door)

The Case Label Set comes in 2 versions - for units with and without the SpO_2 monitoring option. Each of these versions is available in all the supported languages (see Tables 5-13 and 5-14 for part numbers).

See Figure 4-10 and Figure 4-11 for locations of these labels.

Figure 4-10 Instruction Label and Case Label Locations

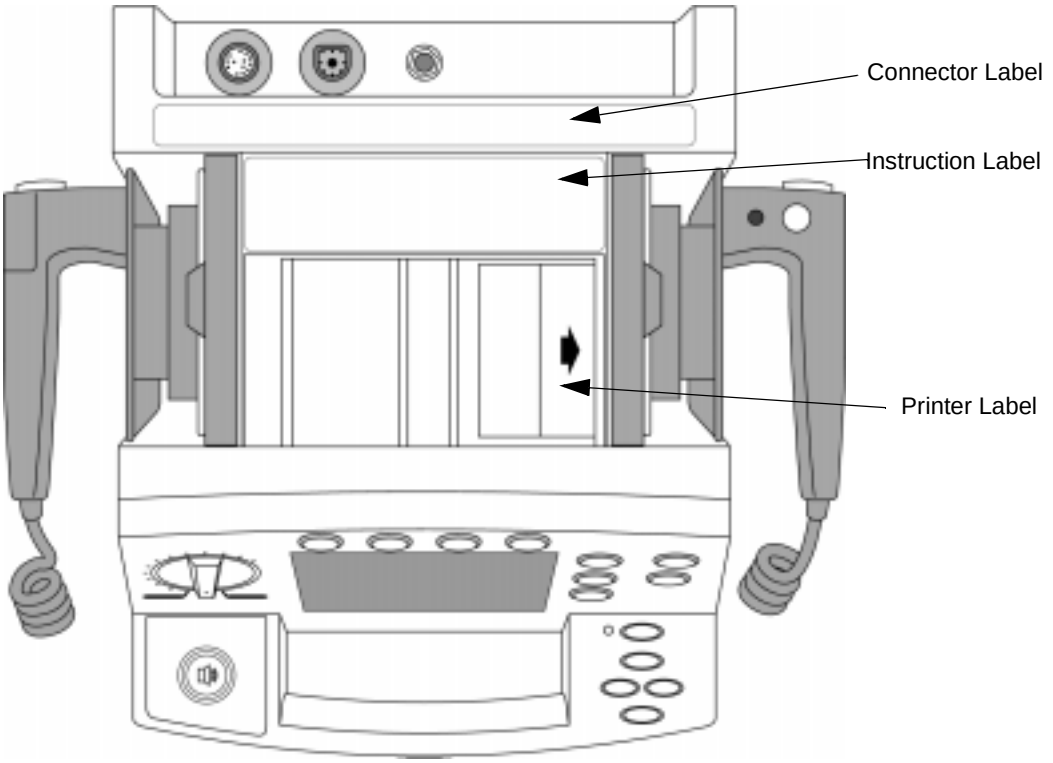
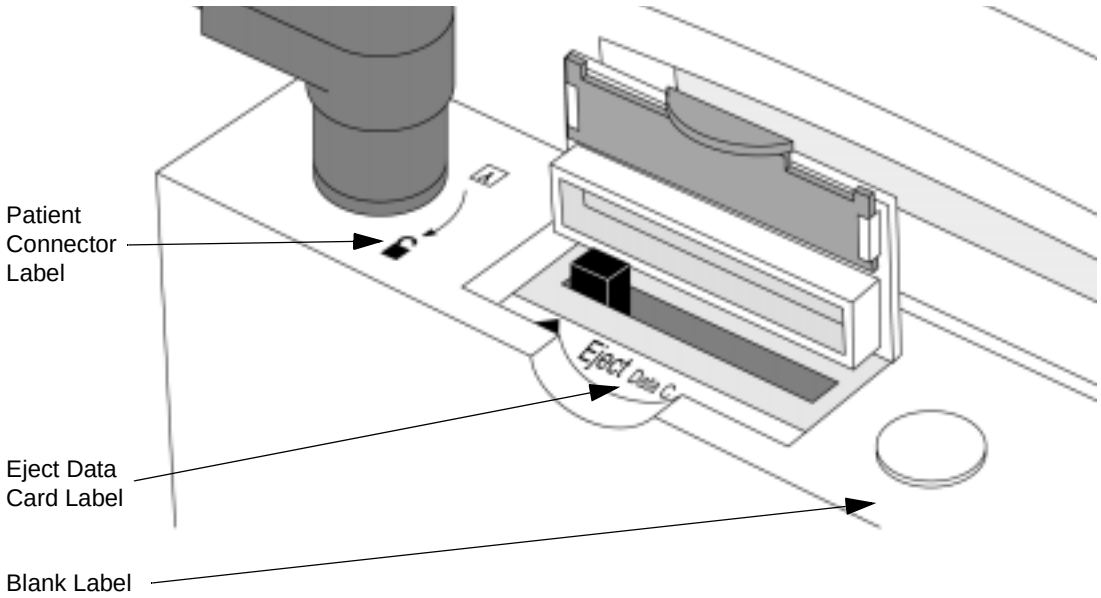


Figure 4-11 Case Label Locations



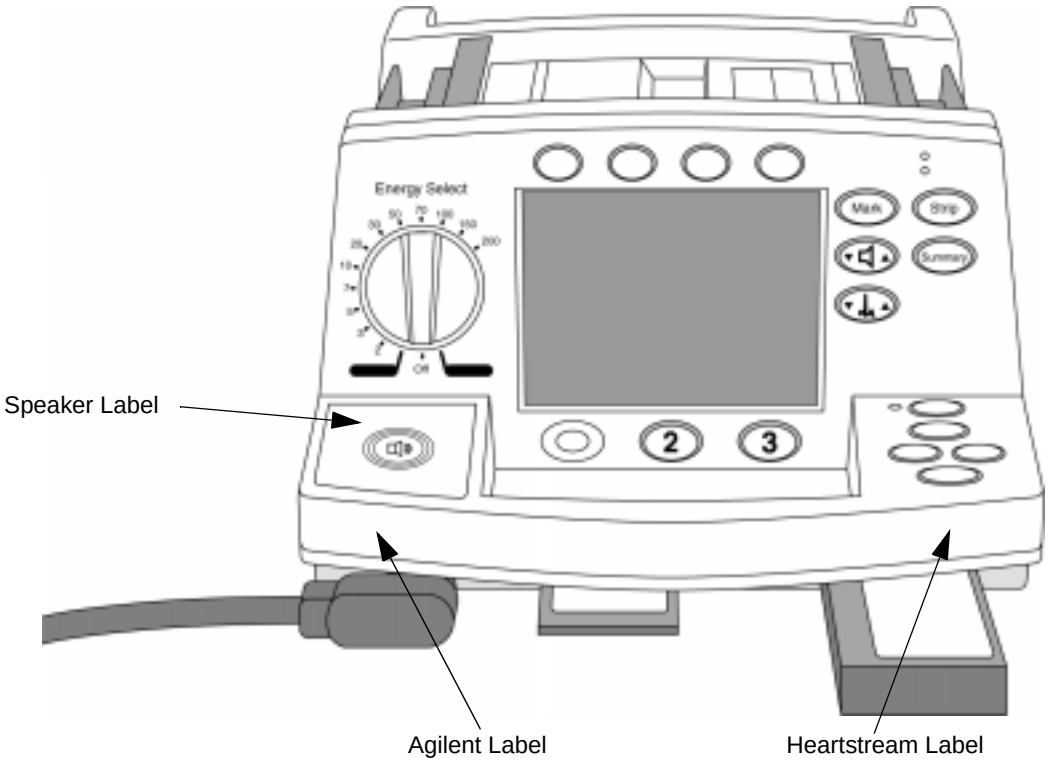
Branding Label Set

Branding labels include:

- Agilent label
- Heartstream label

Both of these are located on the handle. They do not have language localization. See Figure 4-12 for locations.

Figure 4-12 Branding and Speaker Label Locations



Speaker Label Set

The speaker label (cover) seals the speaker grille, and is designed to provide good sound transmission. It consists of a raised circular area surrounded by a gray rectangle. See Figure 4-12 for location.

Removing and Replacing Labels

The following sections describe how to remove and replace any of the labels described earlier.

Removal

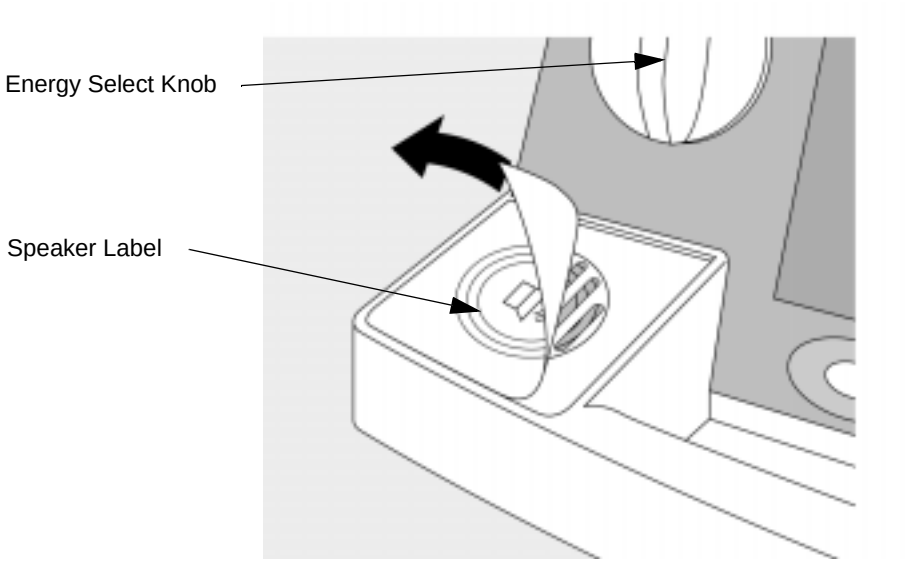
1. **Start at one corner.**

Using a sharp tool such as a utility knife, pick up one corner of the label.

2. **Peel up the label.**

   Peel the label up by pulling slowly and evenly on the loosened corner.

Figure 4-13 Removing the Speaker Label



Replacement

1. **Clean the surface.**

   a. Remove any adhesive residue by rubbing the dry surface with your finger and "rolling up" the adhesive residue. Solvents are ineffective, as is scraping with a tool.

   b. Clean the surface with isopropyl alcohol. Allow it to dry.

2. **Peel off the backing.**

   Peel the backing off the new label. Avoid touching the label adhesive.

3. **Apply the label.**

   a. Align one edge of the label with the recess on the case, then roll the label down slowly into position.

   b. Press firmly all over the label, especially the edges, to ensure it adheres to the case.

After Repair

Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Opening the Case

To open the sealed case ***safely***, perform the following steps, in the order listed:

1. Discharge the Power Supply Capacitors (page 4-24).
2. Separate the Case (page 4-26).
3. Discharge the Defibrillator Capacitor (page 4-30).

Each step is described in more detail in the sections that follow.

Discharge the Power Supply Capacitors

There are 2 methods of discharging the unit's power supply capacitors. Always use the Primary Method first, as it will work in most cases. If there are any doubts, the Secondary Method should also be used.

CAUTION Always discharge the power supply capacitors before servicing the M4735A.

Primary Method

1. **Disconnect the AC power and remove the battery.**
2. **Turn on the unit's power.**
   a. Rotate the **Energy Select** knob to turn on the power. You may hear a "click" from the speaker. If so, ***the power supply capacitors are now discharged.***
   b. If you do ***not*** hear a click, use the Secondary Method. The power supply capacitors may not be discharged.

Secondary Method

1. **Open the case.**

   See "Separate the Case" on page 4-26. Stop after completing step 7. ***DO NOT disconnect the case halves yet***.
2. **Discharge the defibrillator capacitor**

   See "Discharge the Defibrillator Capacitor" on page 4-30. Note the condition of the Discharge Pathway.
3. **Disconnect and remove the defibrillator capacitor.**

   See "Defibrillator Capacitor" on page 4-84. Leave the foam in place on the capacitor wires.
4. **Disconnect the battery connector.**

   Unplug the 4 pin battery connector from the Power PCA. See Figure 4-14.

5. **Use the disarm resistors to discharge the power supply capacitors.**

   a. Using 2 clip leads, connect one clip lead to each end of <u>one</u> of the Disarm Resistors.

   b. Touch the other ends of the 2 clip leads to the two middle pins of the battery connector on the Power PCA. Maintain this connection for at least 5 seconds. ***The power supply capacitors are now discharged.***

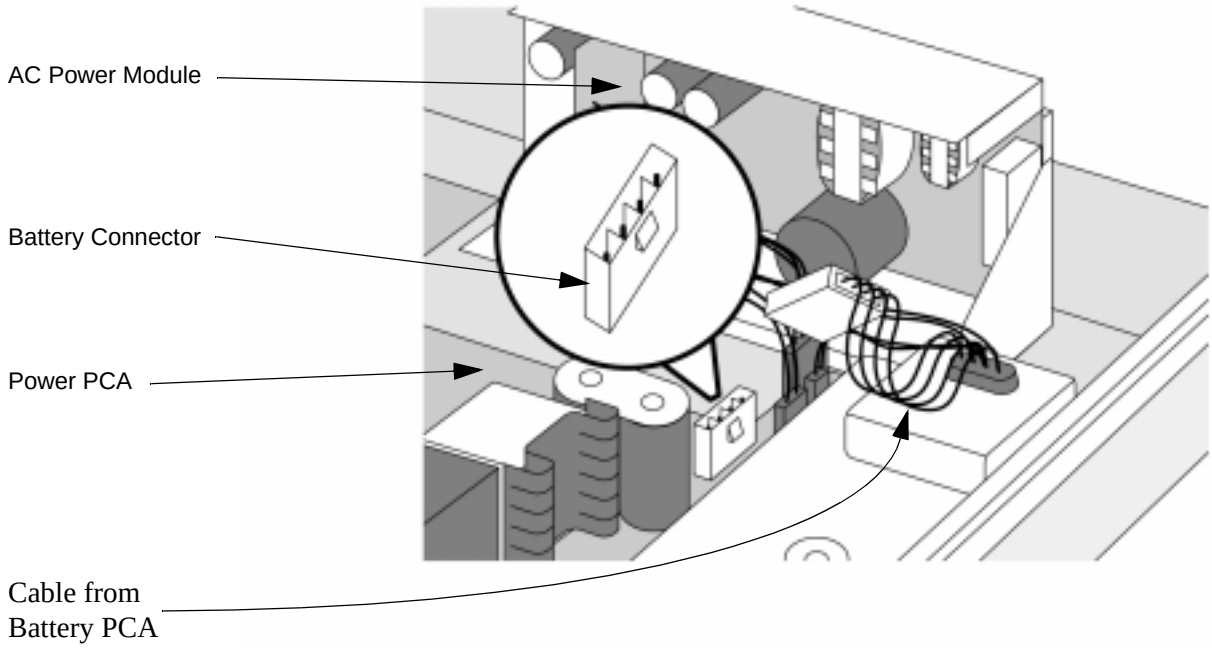
CAUTION

If the Disarm Pathway was found to be damaged in the earlier steps, repeat step 5 using the other Disarm Resistor.

6. **Disconnect the case halves.**

   See "Separate the Case" on page 4-26. Complete steps 8 and 9.

Figure 4-14 Battery Connector Location



Separate the Case

WARNING

Dangerous voltages may be present on components and connections exposed during unit disassembly. Use extreme caution while the unit cover is removed.

CAUTION

Be sure to work in a static free environment. Use an electrostatic wrist band. The work surface and area surrounding it must be static free. Use an antistatic pad which is grounded per the manufacturer's instructions.

1. **Eject the Data Card.**

   Remove the Data Card by pushing its Eject button and pulling the card out.

CAUTION

Be sure the Eject button is fully in - if it is left partially extended it can catch on the bottom case and break off.

2. **Remove the paddles.**

   Disconnect the paddles from the Patient Connector. Snap both paddles out of their retainers and lay them aside.

3. **Turn the unit over.**

   Turn the M4735A upside down (display facing down) with the handle closest to you.

4. **Remove the Battery Cover.**

   See "Battery Cover" on page 4-10.

5. **Remove the case screws.**

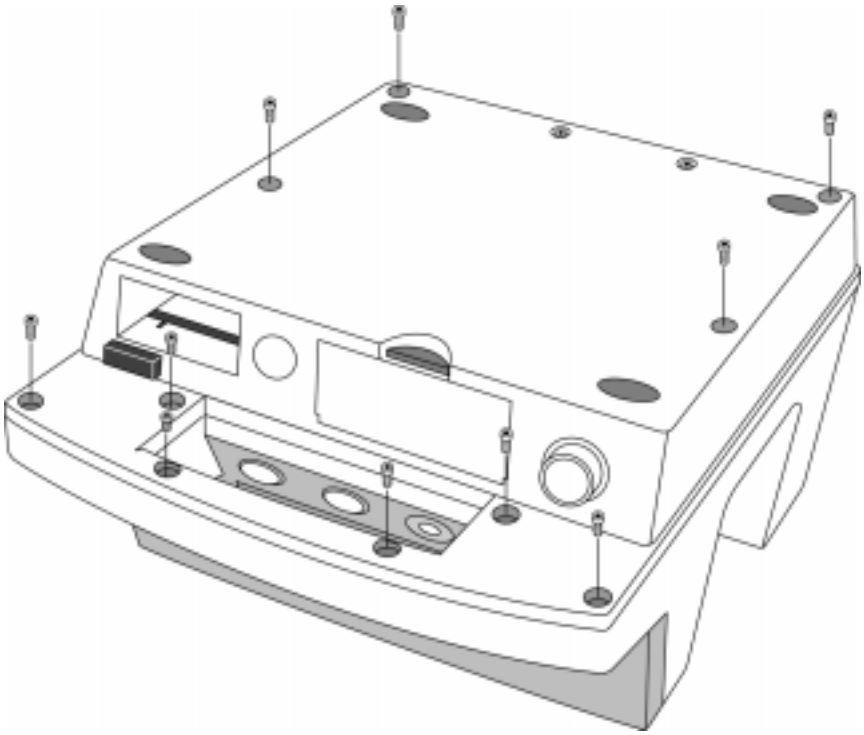
   a. Loosen (4) T15 screws from the bottom of the case. See Figure 4-15. **Do not remove the 2 screws that attach the AC Power Module to the case.**

   b. Loosen (6) T15 screws from the handle. Leave the two halves of the case together.

   c. Turn the unit over so the display is facing up. Keep the handle closest to you. The case screws will fall out of their holes as you do this.

   TIP: To avoid losing any screws, apply tape over the screw holes before turning the case rightside up.

Figure 4-15 Removing the Case Screws



6. **Open the case.**

   a. Start opening the case at the back edge to break any adhesion along the gasket.

   b. Pull the back of the top case up slightly.

   c. Then pull up the front of the top case while sliding it rearward to give the Eject button more room to clear the bottom case.

7. **Pivot the top case to a vertical position.**

   a. Once the case halves are separated, pivot the top case to the right as shown in Figure 4-16.

   b. Stop when the top case is resting on its edge, next to the bottom case.

CAUTION

Do not proceed with the next step until you are sure the power supply capacitors have been discharged.

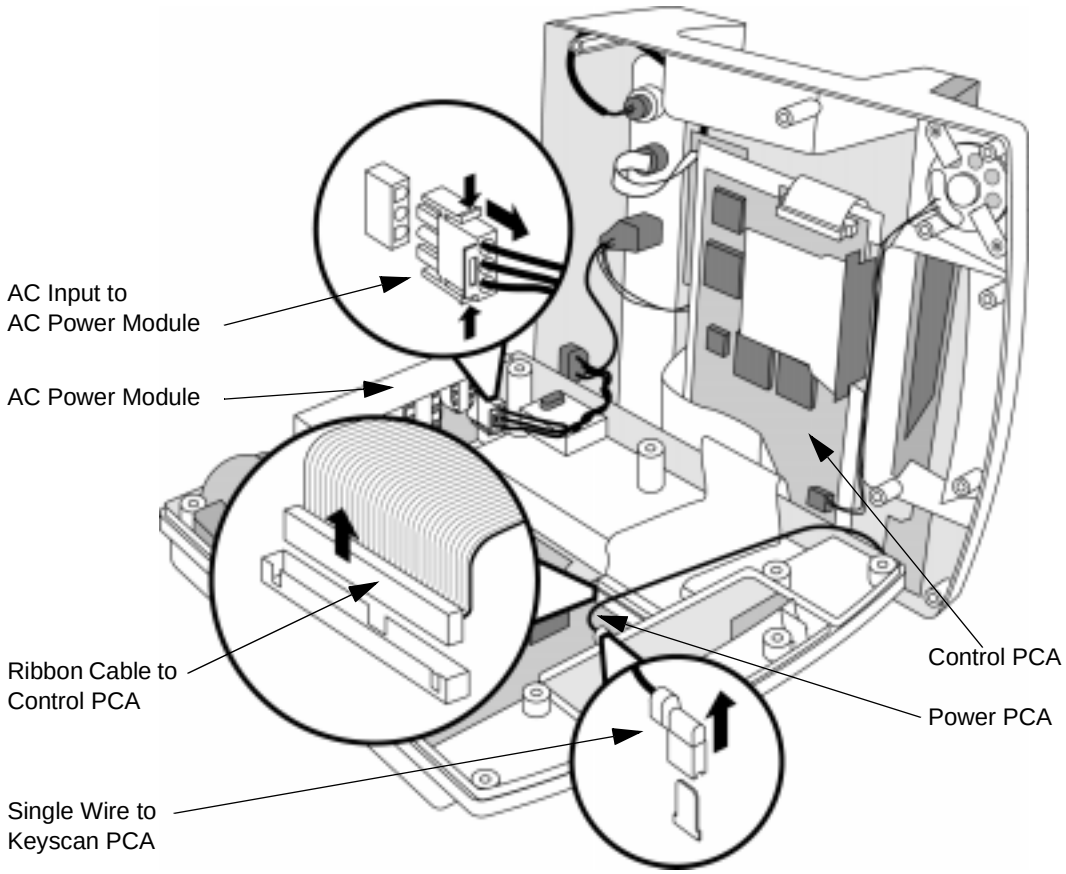
8. **Disconnect the case halves.**

   a. Disconnect the large ribbon cable from the Power PCA (connects to Control PCA).

   b. Disconnect the single wire from the Power PCA by pulling straight up with needle nose pliers (connects to Keyscan PCA).

   c. Disconnect the AC input from the AC Power Module by compressing the 2 latches on the connector pulling the connector straight out from the Module.

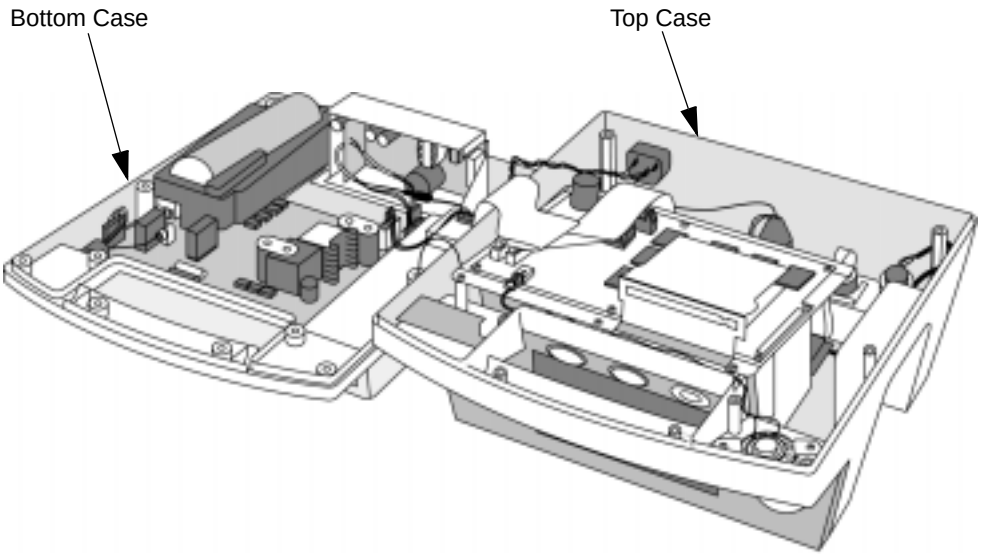
Figure 4-16 Case Opened to Vertical



9. Lay the top case flat on the work surface.

Lay the top case on the work surface upside down and next to the bottom case section. See Figure 4-17.

Figure 4-17 Case Opened Flat



Discharge the Defibrillator Capacitor

The steps that follow describe two methods of discharging the unit's Defibrillator Capacitor. Always employ the Primary Method, as it will work in most cases. If there are any doubts, the Secondary Method should also be used.

WARNING **Always discharge the defibrillator capacitor before servicing this unit.**

WARNING **To avoid completing a high voltage circuit, use only one hand to perform the following steps. Keep the other hand away from the unit at all times. Touch only the parts described.**

1. **Lift the capacitor out of the way.**

   Lift up the defibrillator capacitor together with its foam base. Lift straight up, then turn the capacitor to the right and rest it on the Power PCA. See Figure 4-18.

2. **Inspect the Disarm Pathway.**

   Look for signs of arcing or burning, damage to the resistors or inductor, blown traces on the Power PCA, etc.

   TIP: The Disarm Pathway is located under the Defibrillator Capacitor on the left side of the Power PCA. The Disarm Pathway consists of 2 large power resistors (Disarm Resistors), a red inductor, and the PCA traces that connect them. See Figure 4-18.

3. **Choose a discharge method.**

   - If the Disarm Pathway is intact, refer to See Figure 4-18 on page 4-31. and use the ***Primary Method*** below to discharge the defibrillator capacitor.
   - If you see any burns or damage, the Disarm Pathway may not be intact. Use the ***Primary Method***, then also use the ***Secondary Method*** to discharge the defibrillator capacitor.

Primary Method

a. Using the High Voltage Discharge Tool, first touch one end of the tool's brass bar to the current sensing resistor (the small loop of flat metal). See See Figure 4-18 on page 4-31. .

b. Then pivot the brass bar so its other end contacts the exposed end of the disarm resistor.

c. Maintain contact at these two points for at least 5 seconds. ***The defibrillator capacitor is now discharged.***

Secondary Method

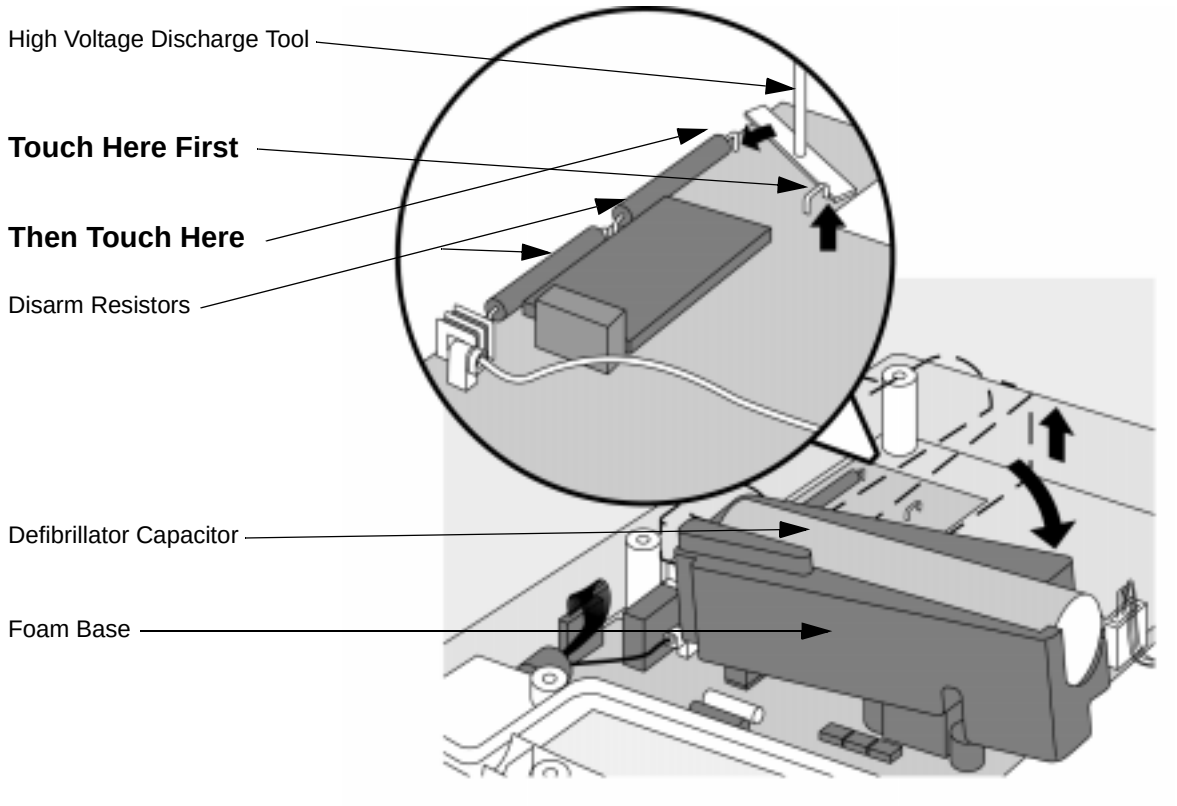
a. Using 2 clip leads, connect one clip lead to each end of one of the Disarm Resistors.

b. Touch the clip leads directly to the spade terminals on the Power PCA where the Defibrillator Capacitor is connected. Maintain this connection for at least 5 seconds.

TIP: Another way to make this connection is to clip the leads to test probe leads, the use the test probes to touch the spade terminals.

c. Repeat steps a and b using the other Disarm Resistor. ***The defibrillator capacitor is now discharged, even if one of the resistors is damaged.***

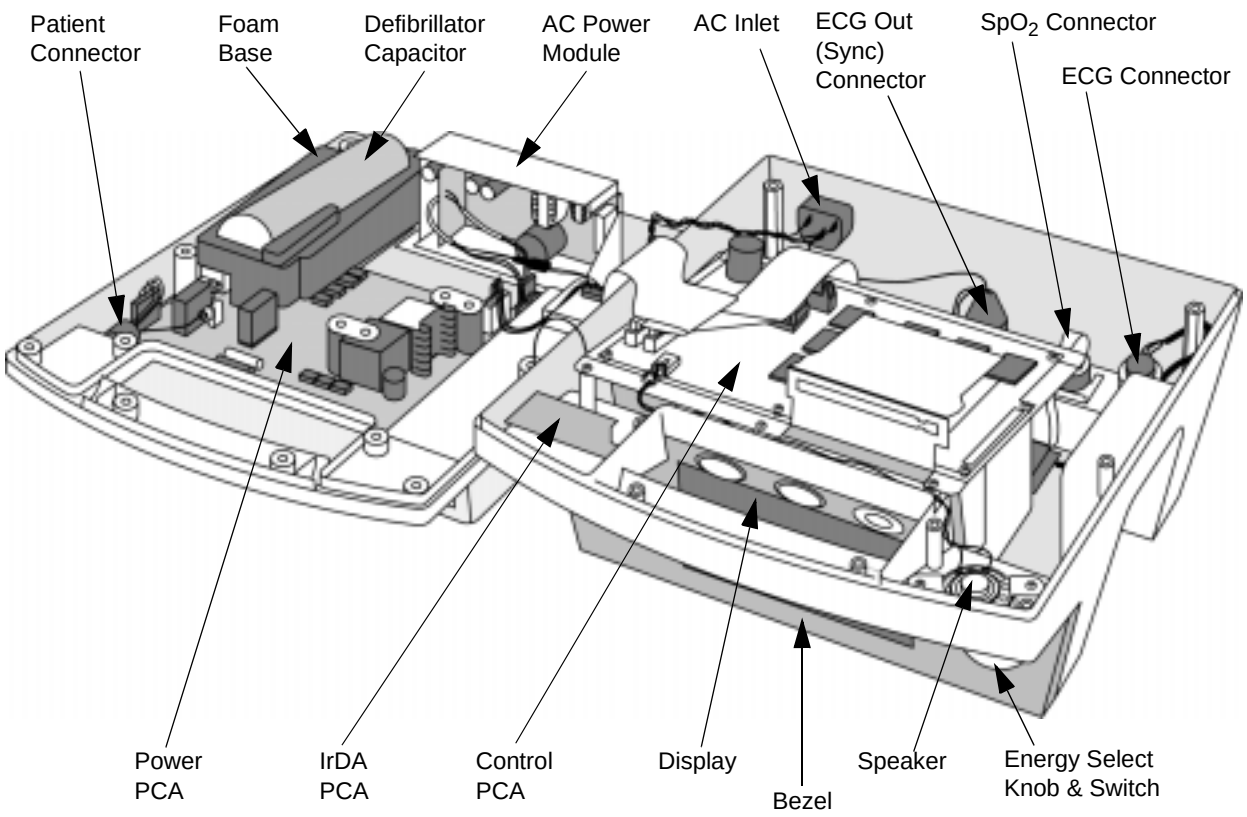
Figure 4-18 Discharging the Defibrillator Capacitor



Identifying Internal Subassemblies

Refer to Figure 4-19 to identify the internal subassemblies.

Figure 4-19 Internal Subassemblies



Internal Assemblies - Top Case

This section provides instructions for removing and replacing assemblies found in the top case. These assemblies include:

Assembly	***Page***
Lithium Backup Battery	4-34
Control PCA	4-36
Shield Plate	4-40
Keyscan PCA	4-42
Bezel Assembly	4-48
Energy Select Switch	4-52
Display Assembly	4-54
Parameter PCA	4-56
SpO2 PCA	4-58
ECG Connector	4-60
SpO2 Connector	4-62
Speaker	4-64
AC Mains Connector	4-66
ECG Out (Sync) Connector	4-69
Pacer Keypad	4-70
Replacement Top Case	4-75

Lithium Backup Battery

The Lithium Battery maintains the unit's stored information on the Control PCA when the main battery is removed or depleted. When replacing the Lithium Battery, also replace the cable tie wrap (ordered separately) that holds it into place. See Table 5-10 on page 5-13 for part numbers.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-36.

Removal

Remove the existing battery.

a. Using a pair of fine nose wire cutters, cut and remove the cable tie wrap that holds the battery in place. See Figure 4-20 and Figure 4-21 for location.

b. Remove the battery from the holder.

Replacement

Install the new Lithium battery.

a. Insert the battery into the holder.

CAUTION

Be sure to install the new battery with the correct orientation. Follow the polarity markings on the bottom of battery holder (under the battery).

b. Secure it in place with a cable tie wrap.

After Repair

After the repair is complete, perform the following steps.

1. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-36.

2. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

3. **Restore the system configuration.**

Use the Software Support Tool to restore the unit's serial number and to select whether SpO_2 hardware is installed or not. See "The Software Support Tool" on page 2-12.

4. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

5. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Control PCA

The steps below describe how to remove and replace the Control PCA. The Control PCA contains the unit's operating software, including the data for the voice prompts. The Control PCA is therefore localized into all the supported languages. See Table 5-2 on page 5-7 for part numbers.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Disconnect the Control PCA (5 cables).**

   a. Disconnect the large ribbon cable on the left side of the Control PCA (connects to the Power PCA). See Figure 4-20 on page 4-37.

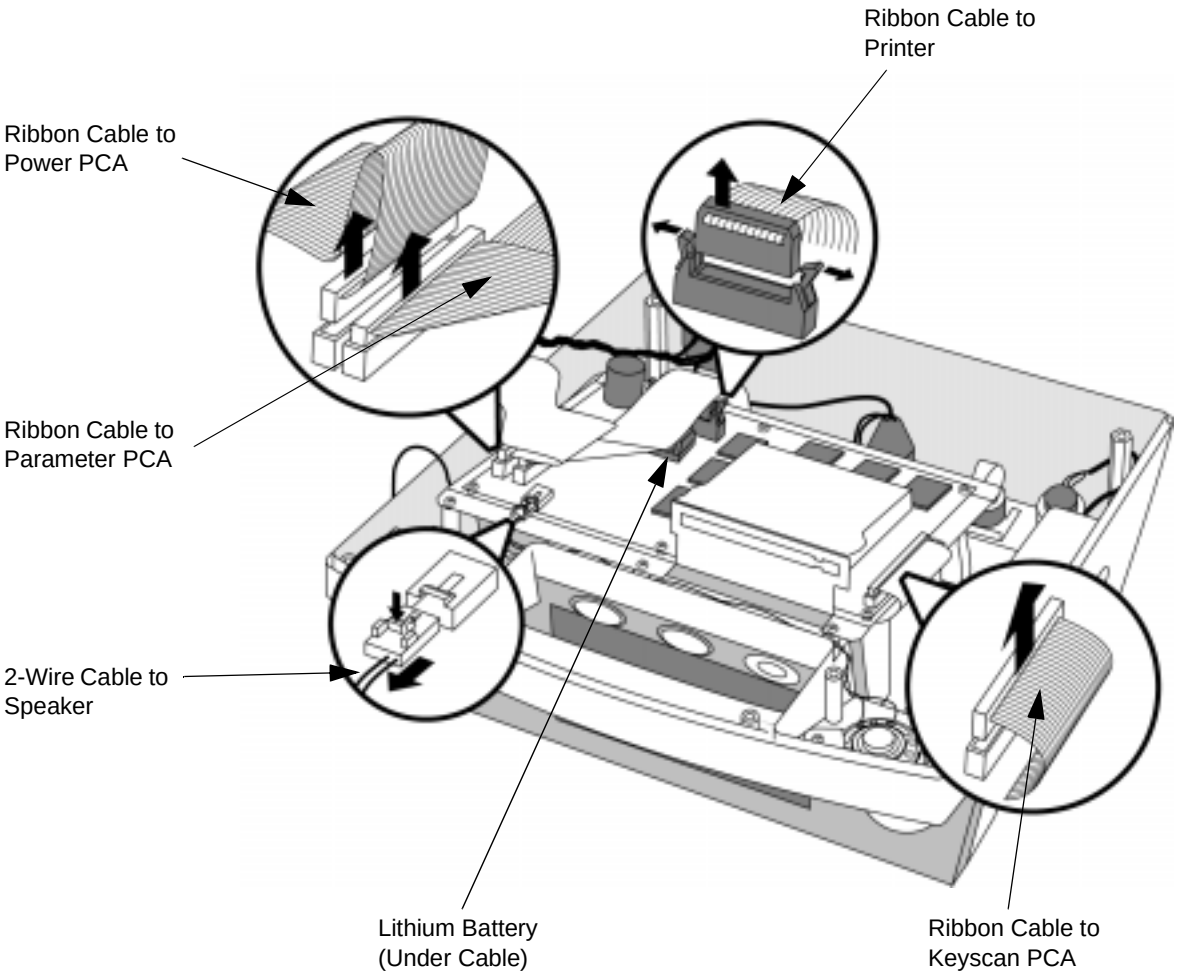
   b. Disconnect the smaller ribbon cable on the left side of the Control PCA (connects to the Parameter PCA).

   c. Disconnect the small ribbon cable at the rear of the PCA (connects to the printer). This requires releasing latches on the ends of connector - push the latches out and down to release them.

   d. Disconnect the small 2-wire connector at the front edge of the PCA (connects to the speaker). This connector has a latch on the top - push down on the latch to release it and wiggle the connector side to side to pull it out.

   e. Disconnect the large ribbon cable on the right side of the Control PCA (connects to the Keyscan PCA).

Figure 4-20 Control PCA Connections



2. **Remove the screws.**

   a. Remove the 8 screws around the edges of the Control PCA. See Figure 4-21 on page 4-38.

   b. Remove the 1 screw near the center of the PCA. Be careful not to damage any nearby components or traces.

3. **Remove the Control PCA.**

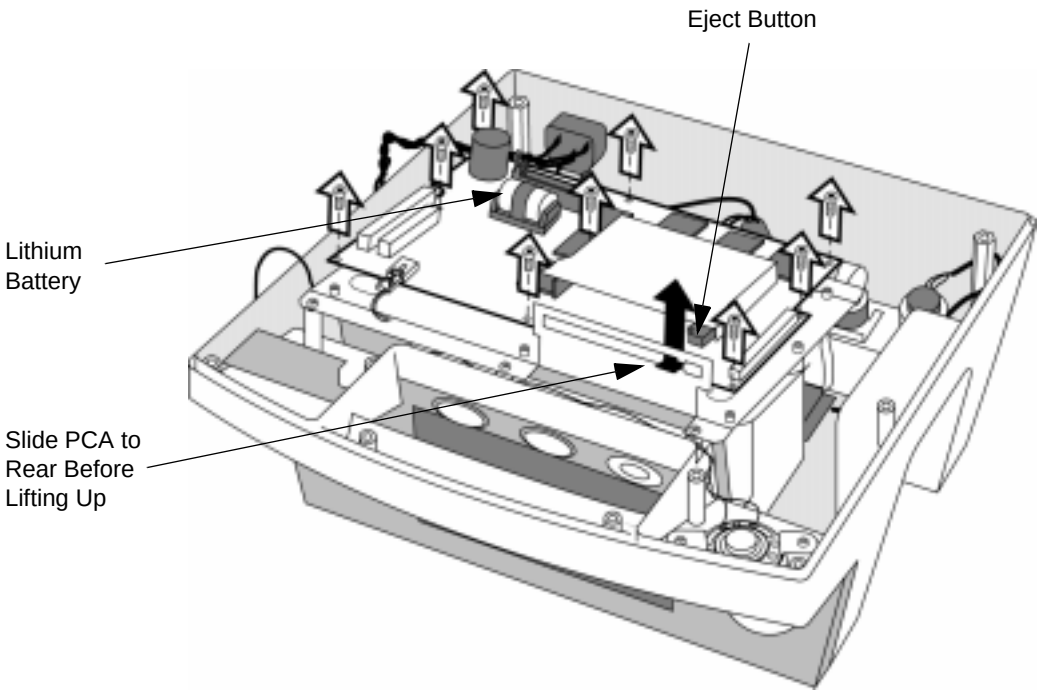
   a. Move the Control PCA toward the rear while lifting it off the metal shield plate. This will help the Eject button clear its hole in the black plastic shield surrounding the Data Card receptacle.

NOTE

If the black plastic shield is damaged, remove it; otherwise leave it in place on the metal shield plate. If you are replacing the Control PCA, the new PCA comes with a new plastic shield.

   b. Leave the lithium backup battery in place when returning the PCA for repair. This will help preserve information for factory troubleshooting.

Figure 4-21 Control PCA Screws



Replacement

1. **Place the Control PCA in position.**

   Line up the holes in the Control PCA with the threaded standoffs on the shield plate. Lower the PCA straight down into position.

CAUTION Do not drag the PCA over the surface of the shield plate to align it.

2. **Replace the screws.**

   TIP: Screw installation is easier if all screws are started in their holes before any one of them is tightened.

3. **Connect the Control PCA.**

   a. Connect the speaker cable.

   b. Connect the printer cable.

   c. Connect the ribbon from the Parameter PCA.

   d. Connect the ribbon from the Keyscan PCA.

4. **Replace the plastic shield, if needed.**

   If the black plastic shield was damaged earlier, replace it now with the one provided with the new Control PCA. Remove any remaining pieces of the old shield, peel the backing paper from the new shield, and press firmly to adhere the shield into place.

After Repair

After the repair is complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

2. **Restore the system configuration.**

   Use the Software Support Tool to restore the unit's serial number and to select whether SpO_2 hardware is installed or not. See "The Software Support Tool" on page 2-12.

3. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

4. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Shield Plate

The sections below describe how to remove and replace the metal Shield Plate located under the Control PCA. This procedure is often needed when removing and replacing other assemblies.

Preparation

Disconnect and remove the Control PCA.

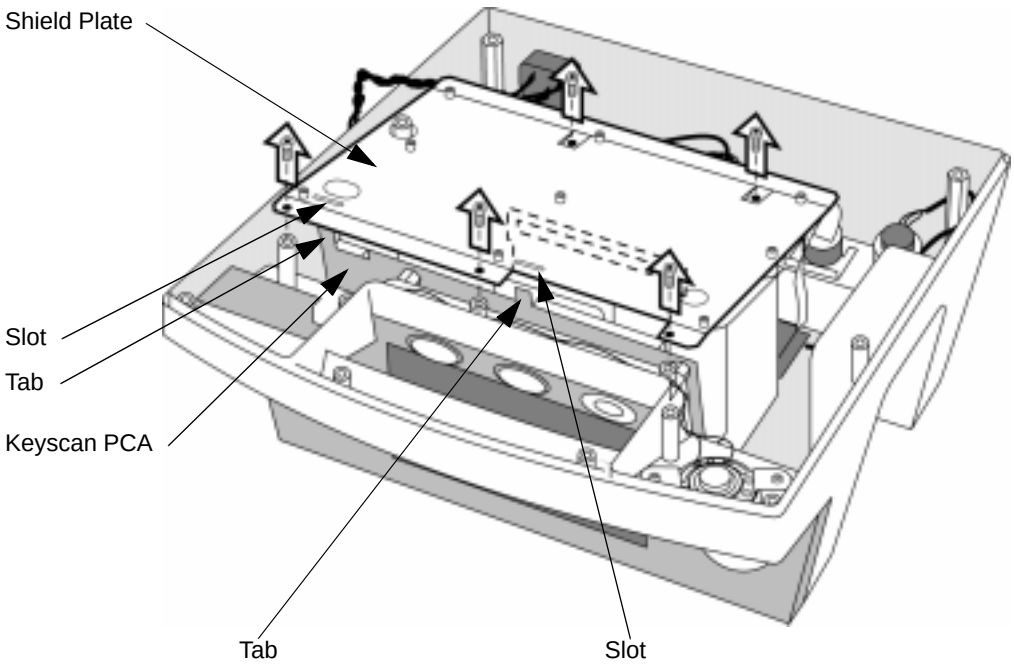
See "Control PCA" on page 4-36.

Removal

a. Remove the 5 screws around the edges of the shield plate. See Figure 4-22 on page 4-40.

b. Lift the plate straight up.

Figure 4-22 Removing the Shield Plate



Replacement

a. Lower the plate into place. Be sure to engage the tabs on the Keyscan PCA into the mating slots in the Shield Plate.

b. Replace the 5 screws.

TIP: Screw installation is easier if all screws are started in their holes before any one of them is tightened.

Keyscan PCA

The following sections describe how to remove and replace the Keyscan PCA.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-36.

4. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-40.

Removal

1. **Disconnect the Keyscan PCA (12 cables).**

   TIP: Position the M4735A with its handle hanging off the edge of your work surface. See Figure 4-23.

   a. Remove the large ribbon cable. See Figure 4-23 on page 4-43. Its other end has already been disconnected from the Control PCA. Note the position and location of the bend in the ribbon cable.

   b. Disconnect the 4 keypad flex circuits. Unlatch the white receptacles on the PCA by pulling upward on the top of the receptacle, then slide out the flex circuit.

      Note that 2 flex circuits (to the Pacing Keypad) are routed around the top edge of the Keyscan PCA, and 2 flex circuits (to the Main Keypad) are routed around the lower edge of the Keyscan PCA.

NOTE If the Pacing option is not installed, there will be only 2 flex circuits.

   c. Disconnect the IrDA break-off PCA. Press on the connector latch to release it.

   d. Disconnect the Energy Select Switch. Press on the connector latch to release it.

   e. Disconnect the 2 display ribbon cables. The larger ribbon connector has latches on the ends of the connector; press them out and down to release the connector. The smaller connector has no latch - just wiggle gently from side to side while pulling it out.

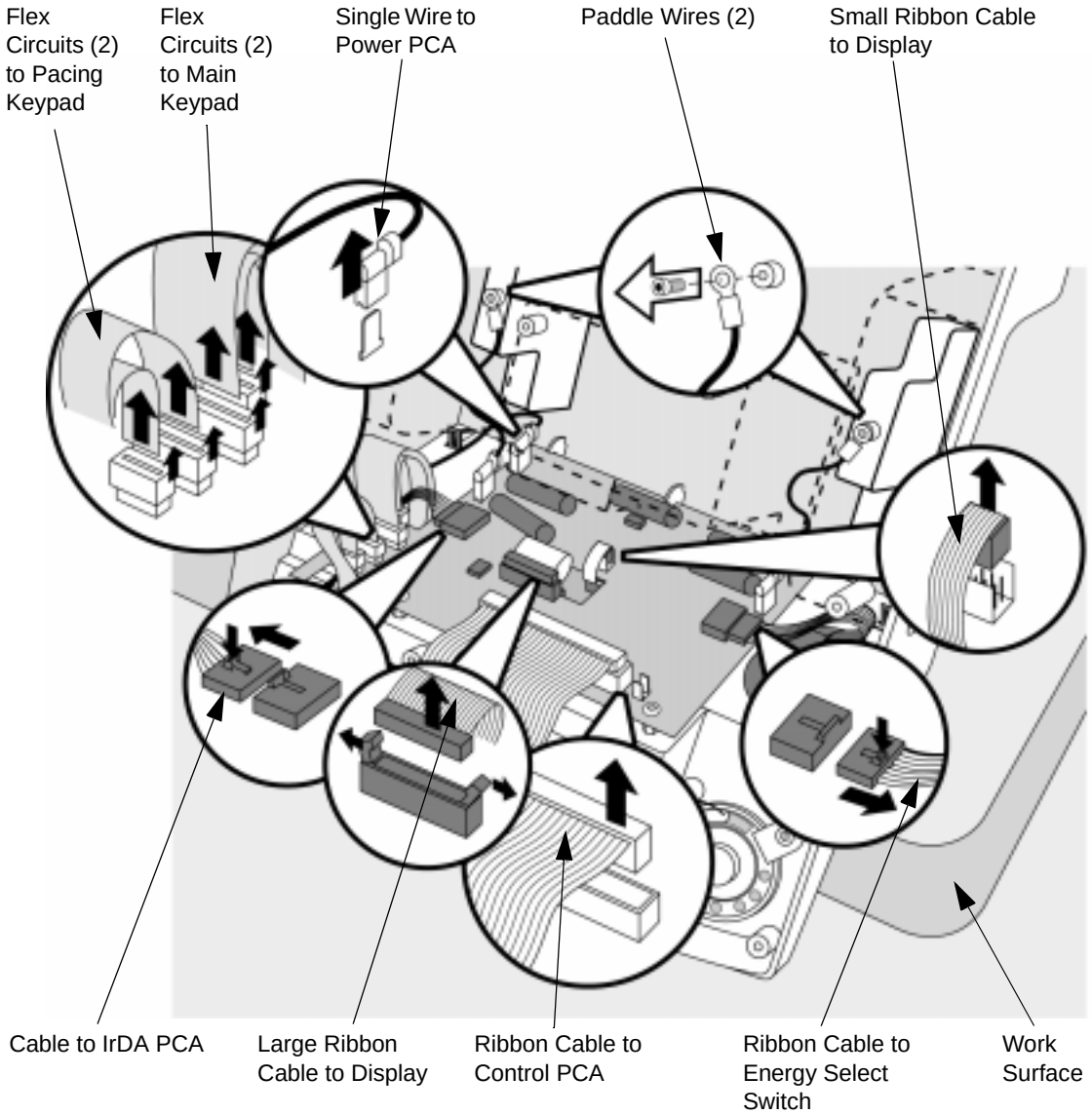
f. Disconnect the 2 paddle wires. Remove the T10 screws that connect them to the threaded inserts under the paddle holders. For now leave the wires connected to the spade connectors on the PCA.

NOTE

These T10 screws are a **different length** than the T10 screws used in the rest of the unit. Keep them separate by screwing them back into the threaded inserts by hand, and leaving them there until needed.

TIP: If the Keyscan PCA is being removed to get access to the Front Bezel or the Display, don't disconnect the paddle wires - after unscrewing the 2 screws (step 2 below), just flip the PCA over and lay it component side down on the underside of the Printer bucket.

Figure 4-23 Keyscan PCA Connections


Flex Circuits (2) to Pacing Keypad
Flex Circuits (2) to Main Keypad
Single Wire to Power PCA
Paddle Wires (2)
Small Ribbon Cable to Display
Cable to IrDA PCA
Large Ribbon Cable to Display
Ribbon Cable to Control PCA
Ribbon Cable to Energy Select Switch
Work Surface

2. **Unscrew and remove the Keyscan PCA.**

   a. Unscrew the 2 T10 screws located at the edge of the PCA nearest you; they attach the PCA to the threaded standoffs. Be sure to unscrew just the screws and not the standoffs.

   b. Lift the Keyscan PCA out of the case and lay it component side up on a static-safe surface.

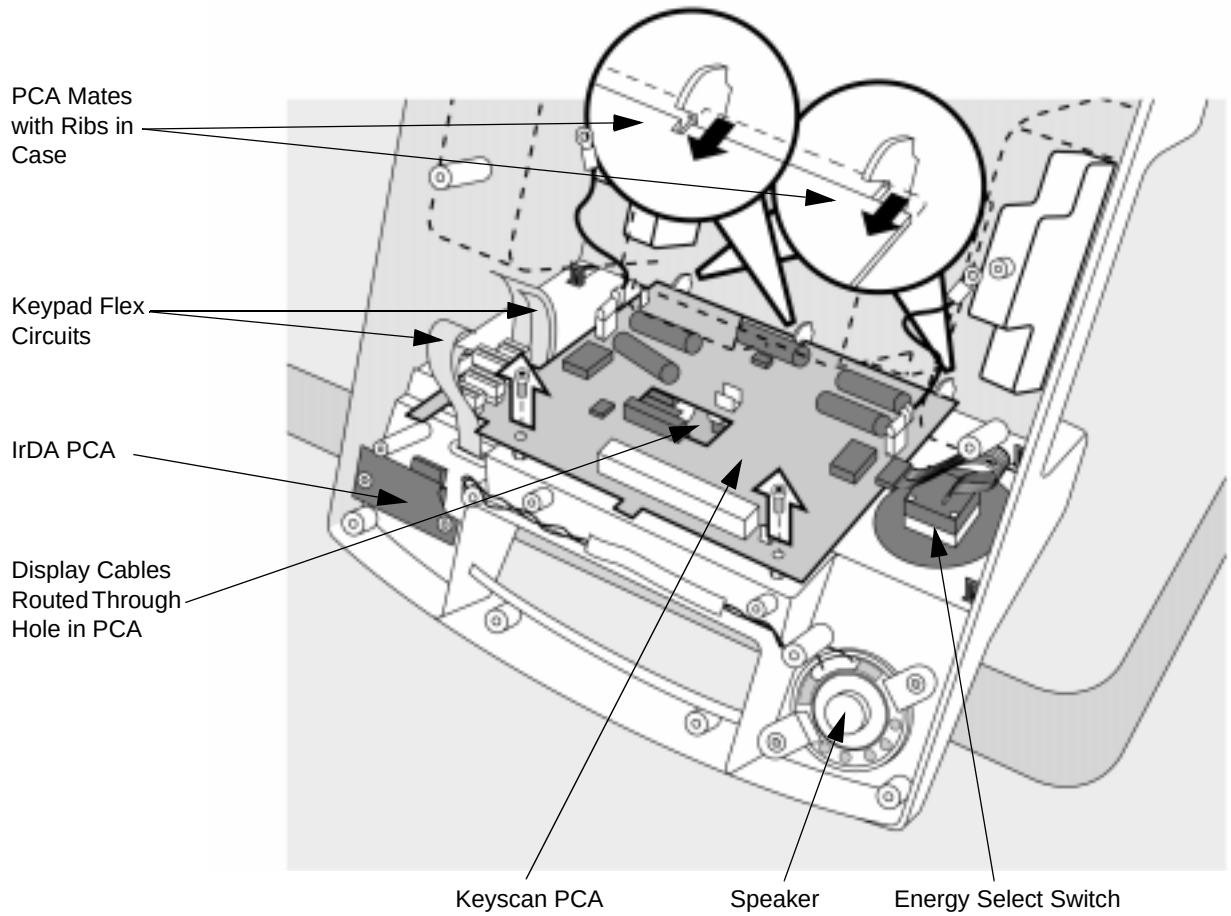
3. **Remove the 3 individual wires.**

   a. Pull straight up with a needle nose pliers to disconnect the 2 paddles wires. Their other ends have already been disconnected from the paddles pockets.

   TIP: Wiggling the spade connectors will help, but use care to not bend the PCA-mounted connections.

   b. Pull straight up with a needle nose pliers to disconnect the one remaining wire. Its other end has already been disconnected from the Power PCA.

Figure 4-24 Keyscan PCA Screws



4. **Unscrew and remove the IrDA break-off PCA. (OPTIONAL)**

   If the Keyscan PCA is being replaced, also remove the IrDA PCA. A replacement IrDA PCA is provided with the replacement Keyscan PCA.

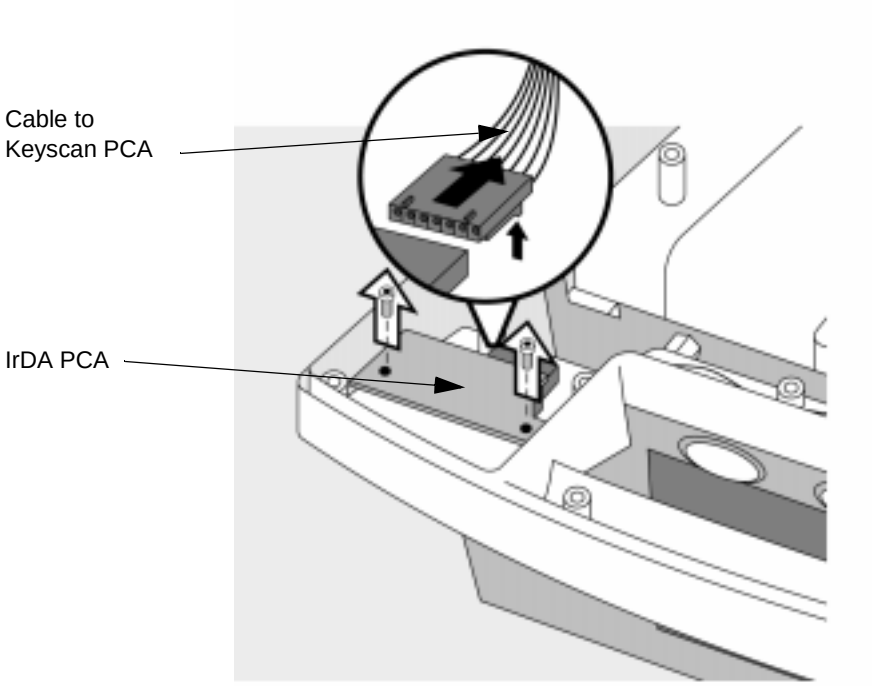
   If the Keyscan PCA is being removed for access to other subassemblies, skip this step.

   a. Remove the 2 T10 screws that attach the IrDA PCA to the case. See Figure 4-25 on page 4-45.

   b. Remove the PCA.

   c. Disconnect the cable from the PCA. Press on the connector latch to release it. Its other end has already been disconnected from the Keyscan PCA.

Figure 4-25 Removing the IrDA PCA



Replacement

1. **Replace the IrDA break-off PCA.**

   If the IrDA PCA was removed, replace it now.

   a. Connect the cable to the IrDA PCA.

   b. Place the IrDA PCA in position inside the top case.

   c. Replace the 2 screws.

2. **Connect the 3 individual wires to the Keyscan PCA.**

   a. Connect the longest wire to the spade connector at the lower left edge of the PCA. This wire has spade receptacles on both ends.

   b. Connect the other 2 wires to the spade connectors at opposite side edges of the PCA (on either end of the power resistors). These wires have ring terminals on their other ends.

3. **Install the Keyscan PCA.**

   a. Align the bottom edge of the PCA with the mating slots in the case. Note that there is a also slot in the PCA which must line up with a rib on the case. See Figure 4-24.

   b. As you lay the PCA against the threaded standoffs, guide the 2 display ribbon cables through the window in the Keyscan PCA.

   c. Replace the 2 T10 screws and tighten.

4. **Reconnect the Keyscan PCA.**

   a. Connect the 2 paddle wires to the paddles pockets. Replace the 2 T10 screws and tighten.

   b. Connect the 2 display ribbon cables. Latch the larger one in position. Be sure the smaller one is fully inserted in its connection.

   c. Connect the Energy Select Switch. Be sure the connector latches into position securely.

   d. Connect the IrDA break-off PCA.

   e. Connect the 4 keypad flex circuits. Have the latching top of the connector up; then slide the flex circuit into place and push the top down to latch it. Route the flex circuits as they originally were, with 2 above and 2 below the Keyscan PCA.

NOTE If the Pacing option is not installed, there will be only 2 flex circuits.

   f. Connect the large ribbon cable, keeping its orientation and bending as they were originally.

After Repair

After the repair is complete, perform the following steps.

1. **Replace the Shield Plate.**

   See "Shield Plate" on page 4-40.

2. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-36.

3. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

4. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

5. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Bezel Assembly

The following sections describe how to remove and replace the Bezel Assembly. The Bezel Assembly comes from the factory with the Main keypad and its rubber overlay preinstalled. The keypad and overlay are not available separately - if the rubber or keypad are damaged, the entire Bezel Assembly must be replaced.

The Bezel Assembly is available in all the supported languages.
See Table 5-6 on page 5-10 for part numbers.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-36.

4. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-40.

5. **Disconnect and remove the Keyscan PCA.**

   See "Keyscan PCA" on page 4-42.

Removal

1. **Unscrew the 2 threaded standoffs.**

   Using a pliers or wrench, loosen the 2 standoffs and remove them. See Figure 4-26 on page 4-49.

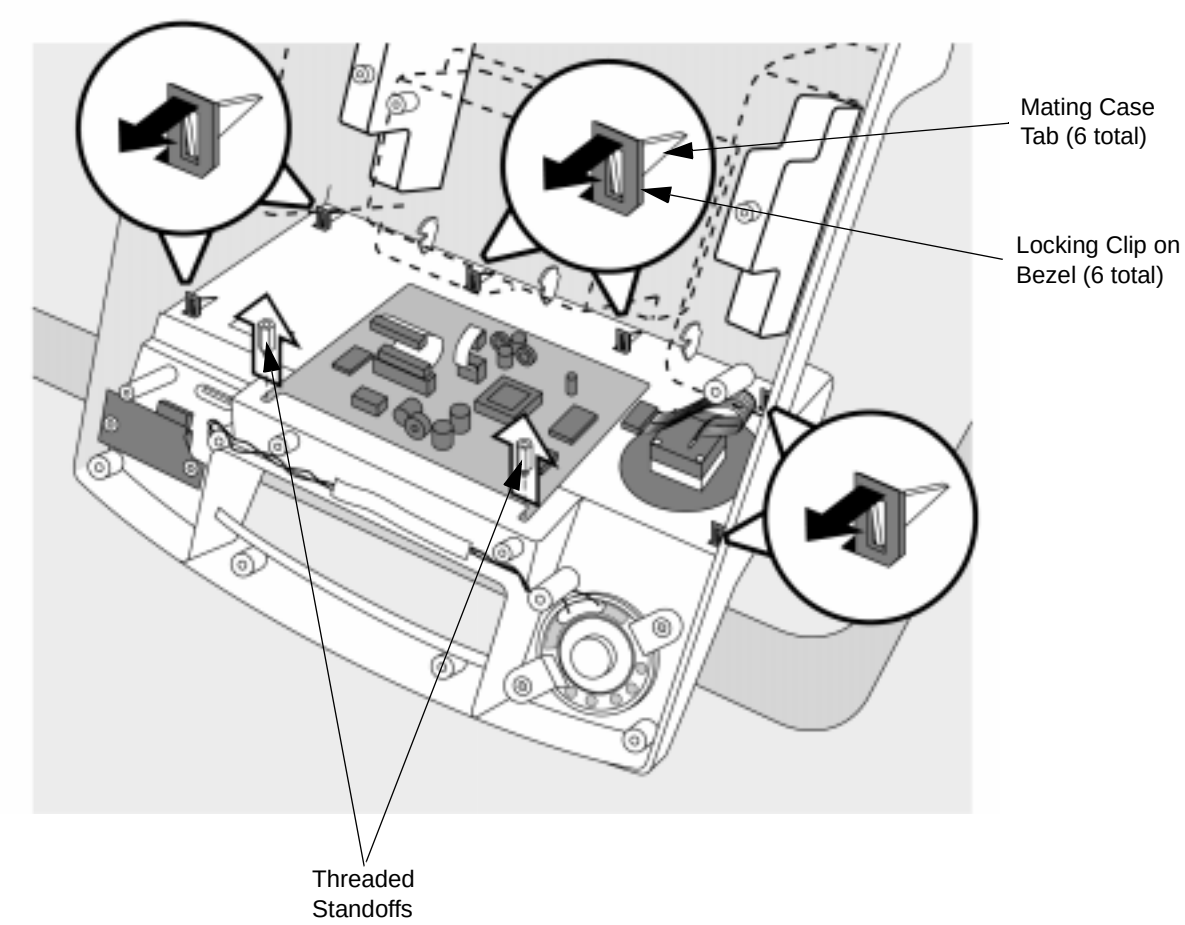
2. **Release the 6 locking clips.**

   Release each of the 6 locking clips (inside the case) by pulling up toward you until the clip unlatches from its mating case tab.

   TIP: Unlatch the 2 clips nearest you first (below the IrDA PCA and below the speaker). Then pivot the Bezel Assembly out from the case and release the 4 clips along the other edge of the Bezel Assembly.

3. **Lift the Bezel Assembly off the front of the case.**

Figure 4-26 Removing the Bezel Assembly



4

4. **Remove the Energy Select knob and switch. (OPTIONAL)**

   If the Bezel Assembly is being replaced, also remove the Energy Select knob and switch. See "Energy Select Switch" on page 4-52.

   If the Bezel Assembly is being removed for access to other subassemblies, skip this step.

5. **Remove the Display Assembly. (OPTIONAL)**

   If the Bezel Assembly is being replaced, also remove the Display Assembly. See "Display Assembly" on page 4-54.

   If the Bezel Assembly is being removed for access to other subassemblies, skip this step.

Replacement

1. **Replace the Display Assembly.**

   See "Display Assembly" on page 4-54.

2. **Replace the Energy Select switch and knob.**

   See "Energy Select Switch" on page 4-52.

3. **Snap the Bezel Assembly onto the front of the case.**

   a. Guide the Energy Select ribbon cable, the Display ribbon cables, and the Keypad flex circuits through their respective openings in the case.

   b. Guide each of the locking clips through its opening in the case.

   c. Press the Bezel Assembly into place. Press firmly to compress the gasket on the case and allow the clips to latch. Be sure all 6 locking clips engage their mating tabs.

4. **Replace the 2 threaded standoffs.**

   Press firmly to compress the gasket and allow the standoffs to engage the threads on the Bezel Assembly.

After Repair

After this repair is complete, perform the following steps.

1. **Replace and reconnect the Keyscan PCA.**

   See "Keyscan PCA" on page 4-42.

2. **Replace the shield plate.**

   See "Shield Plate" on page 4-40.

3. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-36.

4. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

5. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

6. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Energy Select Switch

The following describes how to remove and replace the Energy Select Switch.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

3. **Remove the Energy Select Knob.**

   Grasp the knob and pull straight out from the Front Bezel.

   TIP: To get a better grip on the knob, try wearing rubber gloves.

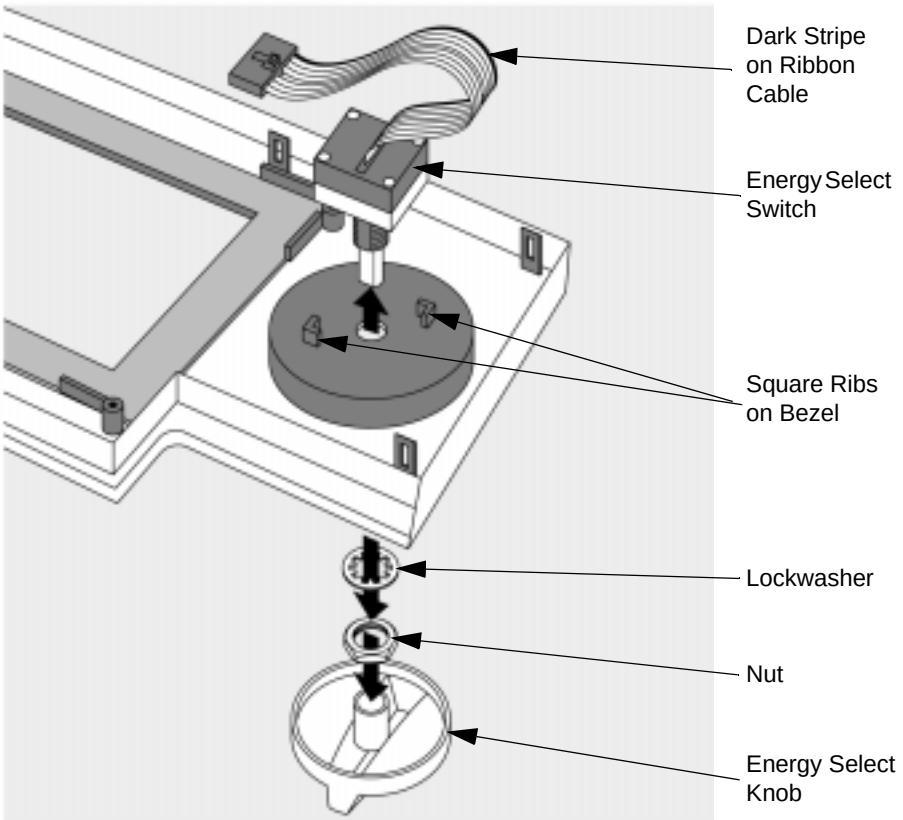
Removal

Disconnect and remove the Energy Select Switch.

a. Unlatch the connector and unplug it from the Keyscan PCA.

b. Using a pliers or wrench, loosen and remove the large nut holding the Energy Select switch into the Bezel. Remove the switch.

Figure 4-27 Energy Select Switch and Knob



Replacement

Replace and reconnect the Energy Select Switch.

a. Insert the Energy Select switch into the hole in the Bezel. Orient it as shown in Figure 4-27.

b. Fit the switch into place between the square ribs on the Bezel. Be sure the switch is fully bottomed against the Bezel.

c. Replace the lockwasher and nut on the shaft. Tighten the nut securely.

d. Plug the connector into the Keyscan PCA. **Be sure it latches.**

After Repair

After this repair is complete, perform the following steps.

1. **Replace the Energy Select Knob.**

   Push the knob onto the shaft. Be sure the knob is pressed fully into place.

2. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

3. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

4. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Display Assembly

The following sections describe how to remove and replace the Display Assembly. The Display Assembly is mounted to the back of the Front Bezel.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-36.

4. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-40.

5. **Disconnect and remove the Keyscan PCA.**

   See "Keyscan PCA" on page 4-42.

6. **Remove the Front Bezel.**

   See "Bezel Assembly" on page 4-48.

Removal

1. **Remove the Display.**

   a. Unscrew the 2 T10 screws in the corners of the Display.
   See Figure 4-28 on page 4-55.

   b. Lift the display off the bezel and set it display side down on a static-protected surface.

2. **Disconnect the 2 ribbon cables from the display.**

   a. Unlatch the larger ribbon connector by pressing out and down on the latches at each end of the connector.

   b. The smaller connector has no latch - just wiggle it gently from side to side while pulling it out.

Replacement

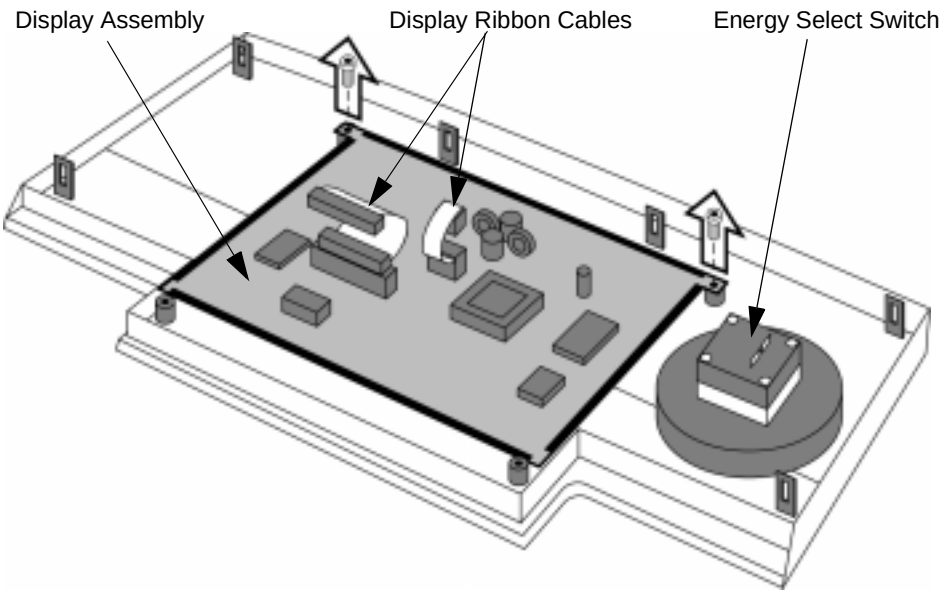
1. **Reconnect the 2 ribbon cables to the Display.**

   Latch the larger one in position; be sure the smaller one is fully inserted.

2. **Replace the Display on the Bezel.**

   Lay the Display on the Bezel and replace the 2 screws.

Figure 4-28 Removing the Display



After Repair

After repairs are complete, perform the following steps.

1. **Replace the Bezel on the case.**

   See "Bezel Assembly" on page 4-48.

2. **Replace and reconnect the Keyscan PCA.**

   See "Keyscan PCA" on page 4-42.

3. **Replace the shield plate.**

   See "Shield Plate" on page 4-40.

4. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-36.

5. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

6. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

7. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Parameter PCA

The Parameter PCA is located in the top case, behind the printer bucket.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after repair.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

3. **Disconnect and remove the SpO_2 PCA.**

   See "SpO2 PCA" on page 4-58.

CAUTION See cautions regarding handling and connection of flex circuits on page 4-1.

Removal

1. **Disconnect the Parameter PCA (4 cables).**

   a. Disconnect the large ribbon cable by pulling straight up (connects to the Control PCA).

   b. Disconnect the small 3 pin connector next to the ribbon cable (connects to the ECG Out Connector). Press on the latch to release it.

   c. Disconnect the cable at the opposite end of the PCA (connects to the ECG Connector). Press on the latch to release the connector.

   d. Disconnect the flex circuit (connects to the SpO_2 PCA). Unlatch the brown receptacle on the PCA by pulling on the top of the receptacle, then slide out the flex circuit.

2. **Remove the Parameter PCA.**

   a. Unscrew the T10 screw located near the large ribbon connector.

   b. Lift the PCA out of the case.

Replacement

1. **Replace the Parameter PCA.**

   a. Connect the SpO_2 flex circuit. Slide the flex circuit into place, then latch the receptacle by pushing in on the top of the receptacle.

   b. Lay the Parameter PCA in position in the top case. The PCA fits between ribs in the case on all 4 corners.

   c. Replace the T10 screw near the large ribbon connector.

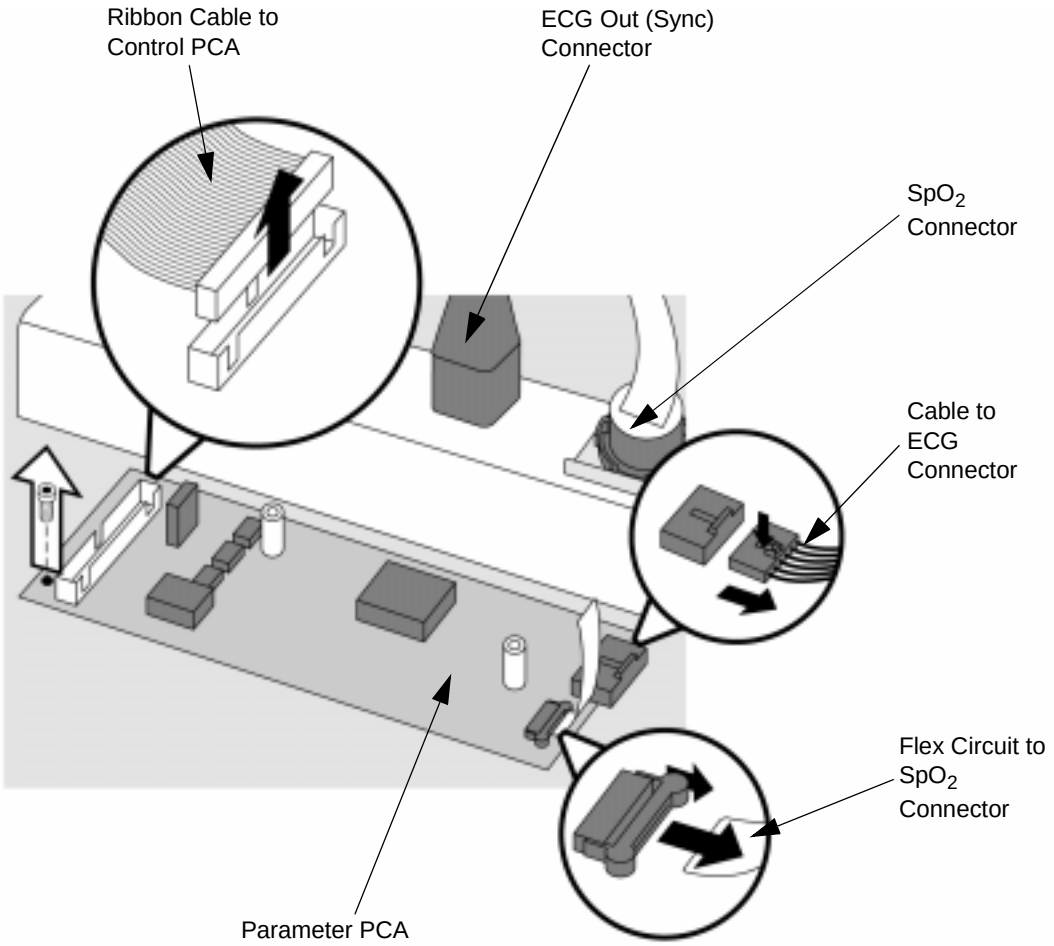
2. **Connect the Parameter PCA.**

   a. Connect the ECG Connector cable. Be sure the connection latches.

   b. Connect the large ribbon cable (connects to the Control PCA).

   c. Connect the small 3 pin connector next to the ribbon cable.

Figure 4-29 Removing the Parameter PCA



After Repair

After repairs are complete, perform the following steps.

1. **Replace and connect the SpO_2 PCA.**

   See "SpO2 PCA" on page 4-58.

2. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

SpO_2 PCA

The SpO_2 PCA is located in the top case, in behind the printer bucket. It is mounted on top of the Parameter PCA. The following sections describe how to remove and replace the SpO_2 PCA.

CAUTION See cautions regarding handling and connection of flex circuits on page 4-1.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Disconnect the SpO_2 PCA.**

   a. Disconnect the flex circuit to the SpO_2 connector. There is no latch; pull straight out from the PCA connector. See Figure 4-30 on page 4-59.

   b. Disconnect the flex circuit to the SpO_2 PCA. Unlatch the brown receptacle on the PCA by pulling on the top of the receptacle, then slide out the flex circuit.

2. **Remove the SpO_2 PCA.**

   a. Remove the 2 long T10 screws. See Figure 4-30 on page 4-59.

   b. Lift the PCA out of the case.

Replacement

1. **Replace the SpO_2 PCA.**

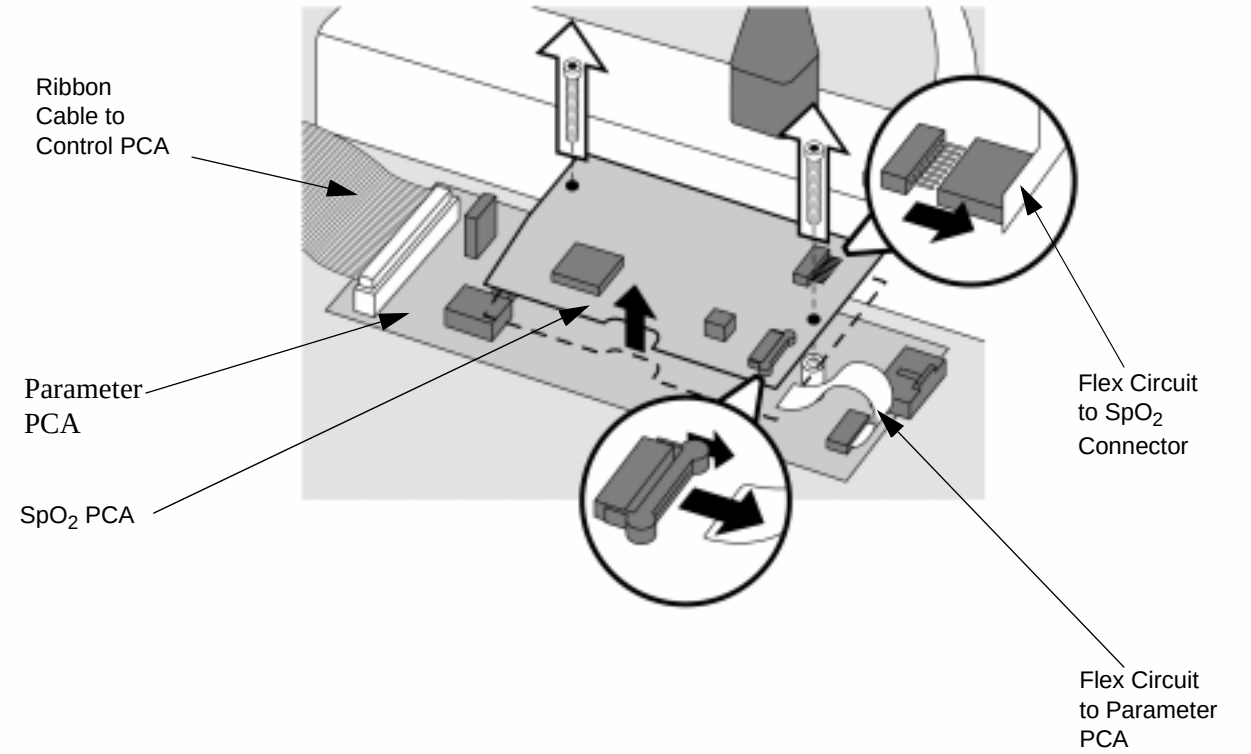
   Lower the PCA into position on top of the Parameter PCA. The SpO_2 PCA should be oriented so the 2 connectors are on top, and pointing to the right.

2. **Connect the SpO_2 PCA.**

   a. Connect the flex circuit from the Parameter PCA. Slide the flex circuit into place, then latch the receptacle on the PCA by pushing in on the top of the receptacle.

   b. Connect the flex circuit from the SpO_2 connector. There is no latch; push straight into the PCA connector. See Figure 4-30 on page 4-59.

Figure 4-30 Removing the SpO_2 PCA



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After Repair

After repairs are complete, perform the following steps.

1. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

2. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

ECG Connector

The ECG connector is located at the back of the top case, next to the SpO_2 connector. The following sections describe how to remove and replace the ECG Connector.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Disconnect the ECG Connector.**

   Disconnect the cable from the ECG Connector to the Parameter PCA at the Parameter PCA. Press on the latch to release the connector. See Figure 4-31 on page 4-61.

2. **Unlatch and remove the ECG Connector.**

   a. Release the locking tabs on the metal clip around the ECG connector using a small flat-bladed screwdriver. Pull and remove the metal clip.

   b. Slide the connector, cable, gasket and ferrite out through the hole in the case.

Replacement

1. **Replace the ECG Connector.**

   a. Using the new gasket that came with the connector, install the gasket in place on the connector. Slide the cable and ferrite back through the hole in the case.

   b. Align the connector and gasket with the notches in the case and insert it in the hole. Make sure the gasket is in place properly, between the connector and the outside of the case.

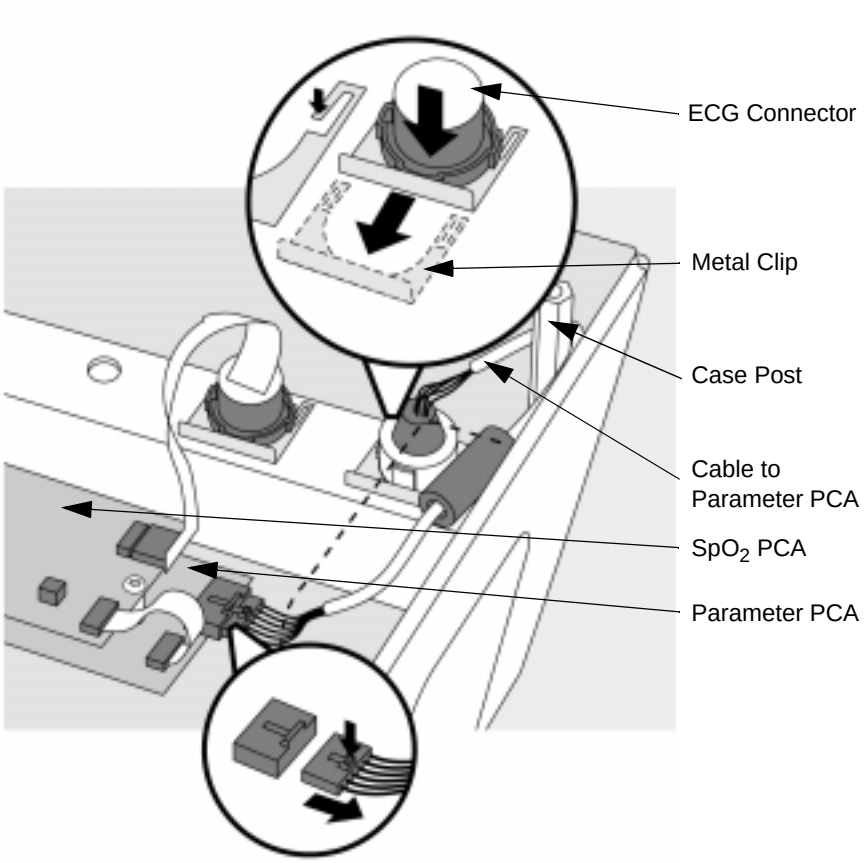
   c. Press in firmly on the connector to compress the gasket. Slide the metal retainer clip into place behind the 2 plastic lugs on the connector, being sure it locks into place. Use the new retainer clip that came with the connector. See Figure 4-31 on page 4-61.

2. **Connect the ECG Connector**

   a. Loop the cable around the case post.

   b. Connect the ECG connector cable to the Parameter PCA, being sure the connector latches.

Figure 4-31 Removing the ECG Connector



After Repair

After repairs are complete, perform the following steps.

1. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

2. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

SpO_2 Connector

The SpO_2 Connector is located at the back of the top case, next to the ECG Connector.

CAUTION See cautions regarding handling and connection of flex circuits on page 4-1.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after repair.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Disconnect the SpO_2 Connector.**

   a. Note the orientation and placement of the flex circuit between the SpO_2 connector and the SpO_2 PCA. Disconnect it at the SpO_2 PCA. There is no latch - just pull it straight out.

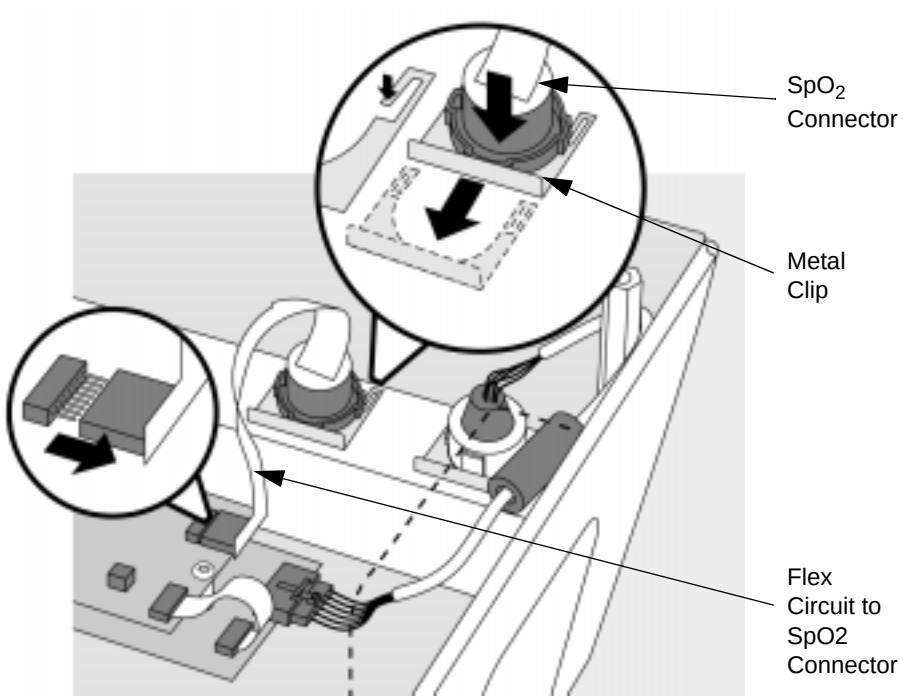
   b. Leave the flex circuit from the SpO_2 PCA to the Parameter PCA connected.

2. **Remove the SpO_2 Connector**

   a. Release the locking tabs on the metal clip around the SpO_2 connector using a small flat-bladed screwdriver. Pull and remove the metal clip. See Figure 4-33 on page 4-64.

   b. Slide the connector, gasket, and flex circuit out through the hole in the case.

Figure 4-32 Removing the SpO_2 Connector



Replacement

1. **Replace the SpO_2 Connector.**
   a. Install the new gasket in place on the new connector. Slide the connector and flex back through the hole in the case.
   b. Align the connector and gasket with the notches in the case and insert it in the hole. Make sure the gasket is in place properly, between the connector and the outside of the case.
   c. Press in firmly on the connector to compress the gasket. Slide the metal retainer clip into place behind the 2 plastic lugs on the connector, being sure it locks into place. Use the new retainer clip that came with the connector. See Figure 4-33 on page 4-64.
2. **Connect the SpO_2 Connector.**
   a. Connect the flex circuit from the SpO_2 connector to the SpO_2 PCA. Line it up carefully, avoiding excessive twisting. There is no latch - just push straight in. See Figure 4-30 on page 4-59.

After Repair

After repairs are complete, perform the following steps.

1. **Restore the customer's configuration.**
   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.
2. **Test performance.**
   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Speaker

These instructions describe how to remove and replace the speaker assembly.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Disconnect the Speaker**

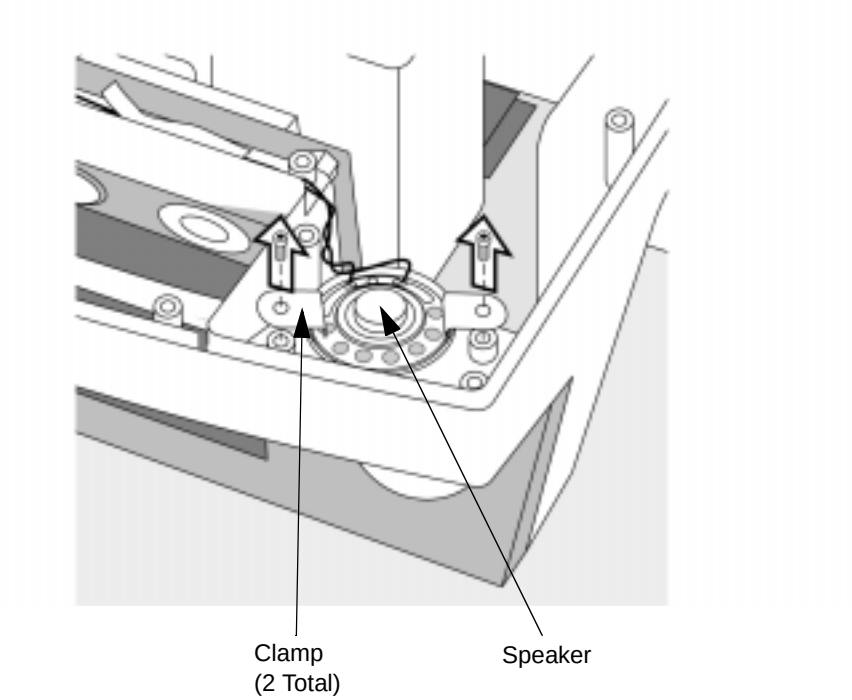
   Disconnect the speaker from the Control PCA. Refer to Figure 4-20 on page 4-37 to identify the speaker connector.

2. **Remove the speaker.**

   a. Remove the 2 screws and clamps from the speaker. See Figure 4-33.

   b. Peel up the tape holding the wires in place. Lift the speaker and its wires out of the case.

Figure 4-33 Removing the Speaker



Replacement

1. **Replace the Speaker.**

   a. Place the new speaker into position in the case.

   b. Install both clamps and both screws. See Figure 4-33 on page 4-64.

   c. Lay the wires in the same position in the case as were the original wires and secure with the original tape (or with other plastic electrical tape).

2. **Connect the Speaker.**

   Connect the speaker to the Control PCA. Refer to Figure 4-20 on page 4-37.

After Repair

After repairs are complete, perform the following steps.

1. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

2. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

AC Mains Connector

The AC Mains Connector is located at the rear of the top case, on the back wall. It is part of one assembly with the ECG Out connector.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Disconnect and remove the ECG Out (Sync) Connector.**

   a. Disconnect the 3 pin connector from the Parameter PCA. Press on its latch to release.

   b. Using a pliers or wrench, loosen the large nut on the ECG Out Connector. Remove the nut and the washer.

   c. Remove the ECG Out Connector from its hole. It will still be attached to the AC Mains Connector.

2. **Remove the AC Mains Connector.**

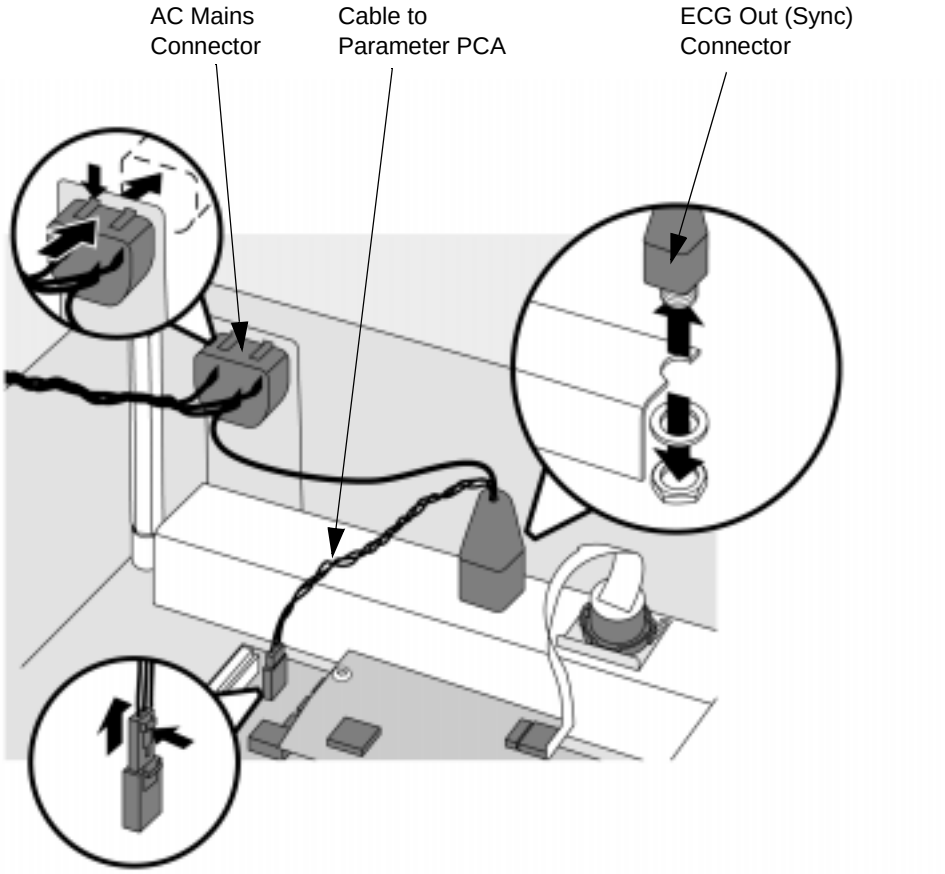
   a. The AC Mains Connector should already be disconnected from the AC Power Module in the bottom case. If it is not, disconnect it now. See "Opening the Case" on page 4-24.

   b. Using a flat bladed screwdriver, press in on the locking tabs on the top of the AC Mains Connector to release the top edge from the case. The tabs will be difficult to depress.

   c. Reach under the AC Mains Connector with your fingers and press in on the locking tab to release the connector from the case.

   d. Remove the AC Mains Connector, along with the ECG Out Connector and the attached cables.

Figure 4-34 Removing the AC Mains and ECG Out Connectors



Replacement

1. **Replace the AC Mains Connector.**

   a. Feed the ECG Out Connector and the attached cables through the hole in the case first, then insert the AC Mains connector into the hole last.

   b. Press the AC Mains connector into place. Be sure all the latches snap into place. It should be oriented as shown in Figure 4-34, with the ground lug (green wire) toward the top of the case.

2. **Replace the ECG Out (Sync) Connector.**

   a. Replace the ECG Out Connector in its hole in the case. Align one of the flat sides against the ribs in the case.

NOTE

One corner of the ECG Out connector is rounded. Keep that away from the ribs, so the ribs can prevent the connector from rotating in either direction.

   b. Replace the washer and nut on the connector, and tighten the nut.

   c. Connect the 3 pin connector to the Parameter PCA. Be sure it latches in place.

After Repair

After repairs are complete, perform the following steps.

1. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

2. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

ECG Out (Sync) Connector

The ECG Out (Sync) Connector is located at the rear of the top case, next to the SpO_2 connector. It is part of one assembly with the AC Mains connector.

For Removal and Replacement procedures, see "AC Mains Connector" on page 4-66.

Pacer Keypad

The following sections describe how to remove and replace the Pacer Keypad.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

3. **Disconnect and remove the Control PCA.**

   See "Control PCA" on page 4-36.

4. **Remove the Shield Plate.**

   See "Shield Plate" on page 4-40.

5. **Disconnect and remove the Keyscan PCA.**

   See "Keyscan PCA" on page 4-42.

6. **Remove the Bezel Assembly.**

   See "Bezel Assembly" on page 4-48.

Removal

1. **Flip the case over and remove the Pacer Keypad.**

   a. Flip the top case over rightside up. Place it on the bottom case for support.

   b. Using needle nose pliers, grasp one corner of the rubber overlay and pull up. The overlay will peel up; the membrane switches underneath may or may not come up with the overlay.

   c. If the membrane switches are still in place, use a sharp tool such as a utility knife to pick up one corner, then peel them up with needle nose pliers. The membrane switches may peel apart into several layers - be sure to remove all layers.

   d. Slide the 2 flex circuit tails out of the slot in the case.

Figure 4-35 Peeling up the Rubber Overlay

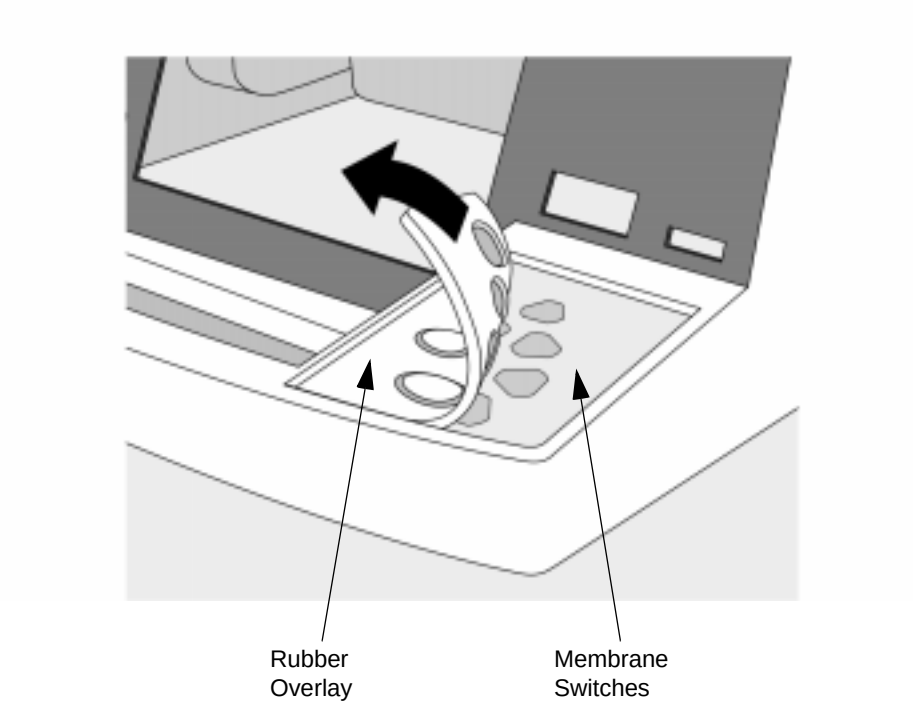
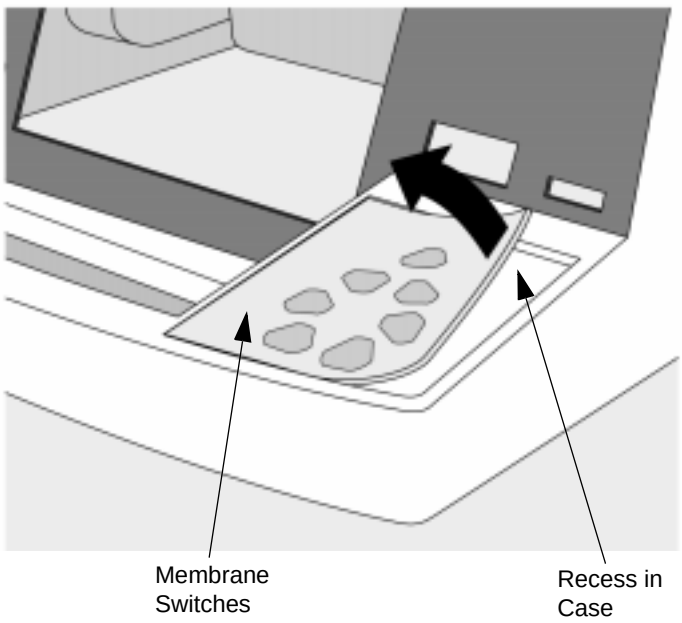


Figure 4-36 Peeling up the Membrane Switches



Replacement

1. **Prepare the case.**

   a. Clean off all adhesive residue from the case by rubbing the dry surface with your finger and 'rolling up' any adhesive.

   TIP: Lightly scoring the adhesive with a rounded tool will aid removal. Solvents are ineffective, as is scraping with a sharp tool.

NOTE

The adhesive used is difficult to remove. Take your time and do a thorough job to ensure a correct seal with the new switches and overlay.

   b. Clean surfaces thoroughly with isopropyl alcohol (an alcohol wipe is fine). Allow to dry completely.

2. **Replace the membrane switches.**

   a. Feed the 2 flex circuits down through the slot in the case as shown in Figure 4-37 on page 4-73.

   b. Peel the backing material off the new switches. Handle very carefully and touch the adhesive as little as possible.

   c. Starting with the top edge, align the switches very carefully in their recess in the case and roll them down slowly into place. Be careful not to kink the flex circuit tails as you slide them into their slot under the switches.

   d. Press firmly all over, especially the edges, to adhere the new switches into place and seal the case opening.

3. **Replace the Overlay.**

   a. Clean the surfaces of the case and membrane switches (NOT the rubber overlay) thoroughly with isopropyl alcohol (an alcohol wipe is fine). Allow to dry completely.

   b. Peel the backing material off the Rubber Overlay. Handle carefully and touch the adhesive as little as possible.

   c. Starting with the top edge, align the Overlay exactly and roll it down slowly into place. See Figure 4-38 on page 4-73.

   d. Press firmly all over, especially the edges, to adhere the new Overlay into place.

Figure 4-37 Installing the Membrane Switches

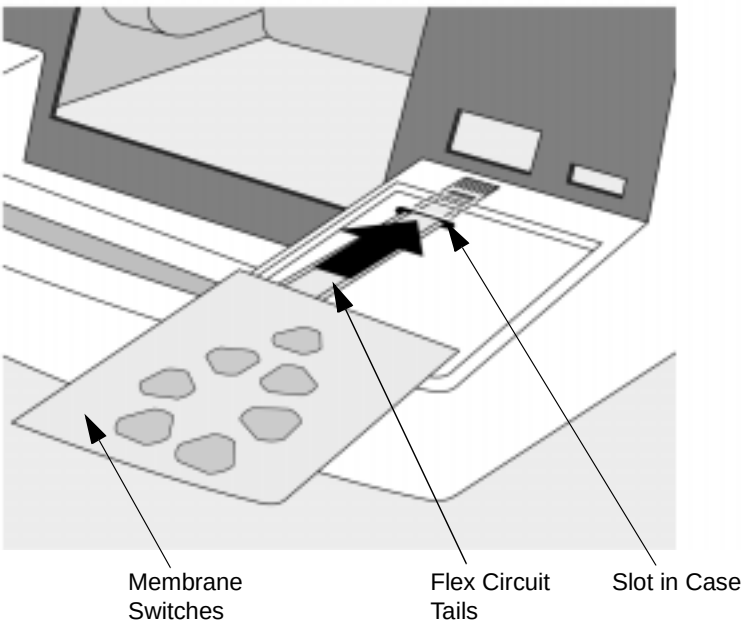
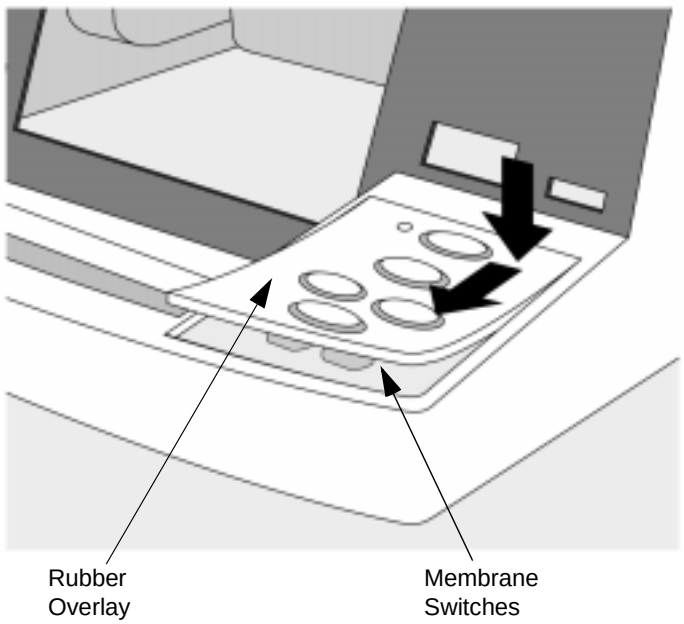


Figure 4-38 Replacing the Rubber Overlay



After Repair

After repairs are complete, perform the following steps.

1. **Replace the Bezel.**

   See "Bezel Assembly" on page 4-48.

2. **Replace the Keyscan PCA.**

   See "Keyscan PCA" on page 4-42.

3. **Replace the Shield Plate.**

   See "Shield Plate" on page 4-40.

4. **Replace and reconnect the Control PCA.**

   See "Control PCA" on page 4-36.

5. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

6. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

7. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Replacement Top Case

The following sections describe how to remove and replace the Top Case Assembly.

Description

The top case assembly consists of the following components, all preassembled into the case at the factory.

- Bezel gasket.
- IRDA lens.
- Printer ribbon cable.
- Case standoffs (tall hex posts).
- Hole plug and gasket (for SpO_2 hole).
- Speaker label.
- Branding labels.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal and replacement

The Top Case is probably the most difficult and time consuming repair that can be done on the M4735A:

- Several existing parts need to be moved from the old case to the new.
- Several new parts must be installed -
  - some come with the top case.
  - some must be ordered separately.

Parts to be moved from old top case to new

The following subassemblies must be removed from the old top case and installed into the new one. Follow the Removal and Replacement instructions in this chapter for each subassembly. Remove them in the order shown, and replace them in reverse order.

1. Printer (see "Printer Assembly" on page 4-6).
2. Paddle Holders (see "Paddle Holders" on page 4-18).
3. Control PCA (see "Control PCA" on page 4-36).
4. Shield Plate (see "Shield Plate" on page 4-40).
5. IrDA break-off PCA (see "Keyscan PCA" on page 4-42).
6. Keyscan PCA (see "Keyscan PCA" on page 4-42).
7. Bezel Assembly (with Energy Select switch and Display attached) (see "Bezel Assembly" on page 4-48).
8. AC Mains Connector and ECG Out Connector (see "AC Mains Connector" on page 4-66).
9. SpO_2 connector and flex circuit (if present) (see "SpO2 Connector" on page 4-62).
10. ECG connector and cable with ferrite (see "ECG Connector" on page 4-60).
11. SpO_2 PCA (if present) and flex circuit (see "SpO2 PCA" on page 4-58). The flex circuit will be reused.
12. Parameter PCA (see "Parameter PCA" on page 4-56).
13. Speaker and mounting hardware (see "Speaker" on page 4-64).

New parts to be installed - provided with top case

The Replacement Top Case Assembly comes with the following new components, which must be installed in the field. ***Do not reuse the old gaskets or retaining clips.***:

- ECG/SpO_2 connector gaskets (not available separately) (see "ECG Connector" on page 4-60 and "SpO2 Connector" on page 4-62).
- ECG/SpO_2 connector retaining clips (M2475-07101) (see "ECG Connector" on page 4-60 and "SpO2 Connector" on page 4-62).
- Short hex standoffs (see "Keyscan PCA" on page 4-42).

New parts to be installed - must be ordered separately

In addition, the following parts cannot be reused from the old case, and must be ordered separately and installed into the new top case:

- Pacer Keypad (if Pacing option ***is*** installed) (see "Pacer Keypad" on page 4-70).

  This is available in all the supported languages.
  See Table 5-7 on page 5-11 to select the correct language.

- Blank Pacer cover (if Pacing option is ***not*** installed)

- Instruction Label Set

  These are available in 2 versions (pacing, no pacing) and in all the supported languages. See Table 5-11 on page 5-14 and Table 5-12 on page 5-15 to select the correct version and language.

- Case Label Set

  These are available in 2 versions (SpO_2, no SpO_2), and in all the supported languages. See Table 5-13 on page 5-16 and Table 5-14 on page 5-17 to select the correct language.

After Repair

After repairs are complete, perform the following steps.

1. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

2. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Internal Assemblies - Bottom Case

The sections that follow describe removing and replacing assemblies that reside in the Bottom Case. These assemblies include:

Assembly	***Page***
Battery PCA	4-80
Defibrillator Capacitor	4-84
Power PCA	4-86
AC Power Module	4-90
Patient Connector	4-94
Replacement Bottom Case	4-97

Battery PCA

The Battery PCA is mounted in the Battery compartment, under the Battery Cover. It has a cable assembly that enters the case through a rubber gasket. Once inside the case, the cable assembly connects to the Power PCA and to the AC Power Module.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Unplug 3 connectors from the Battery PCA.** See Figure 4-39 on page 4-81.

   a. Unplug the 4 pin connector to the Power PCA (the battery connector).

   b. Unplug the 2 pin connector to Power PCA.

   c. Unplug the 2 pin connector to the AC Power Module.

2. **Pull the Battery PCA up.** See Figure 4-40 on page 4-81.

   a. Stand the bottom case up on its edge.

   b. Pull the Battery PCA straight up out of its slot in the bottom case.

3. **Pull out the wires and gasket.**

   a. Remove the gasket from its hole in the case.

   TIP: Depress the tabs on the gasket (inside the case) with a small straight-bladed screwdriver. Then pull from the outside of the case and push from the inside to work the gasket free.

   b. Guide the wires and their connectors out of the hole.

Figure 4-39 Battery PCA connections

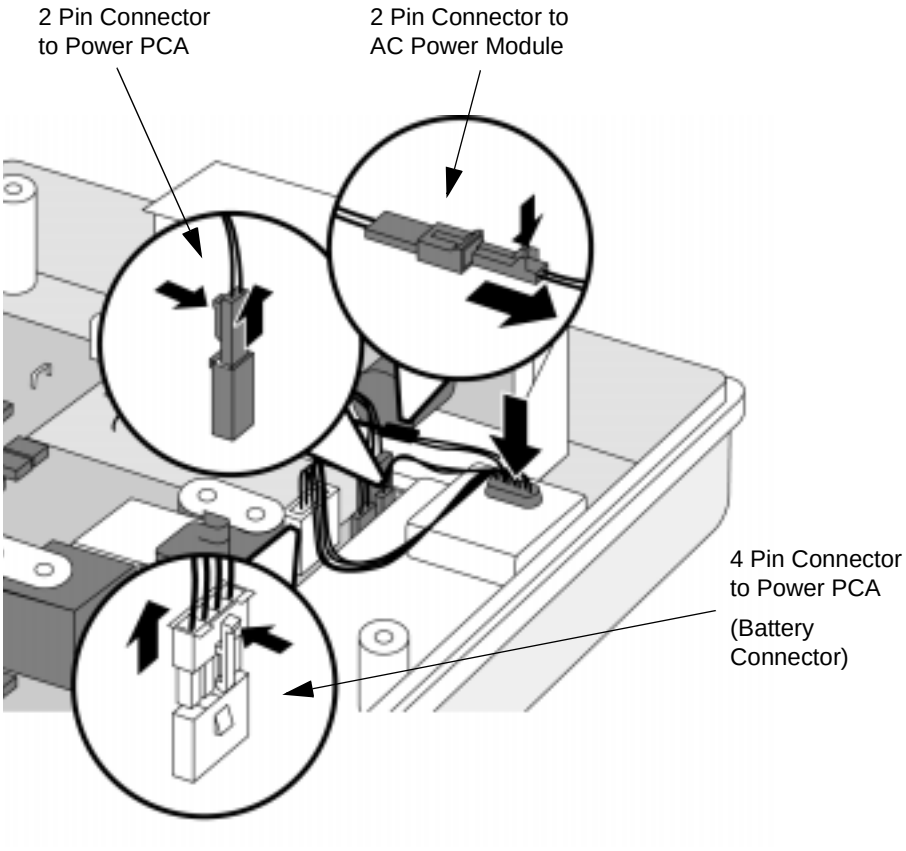
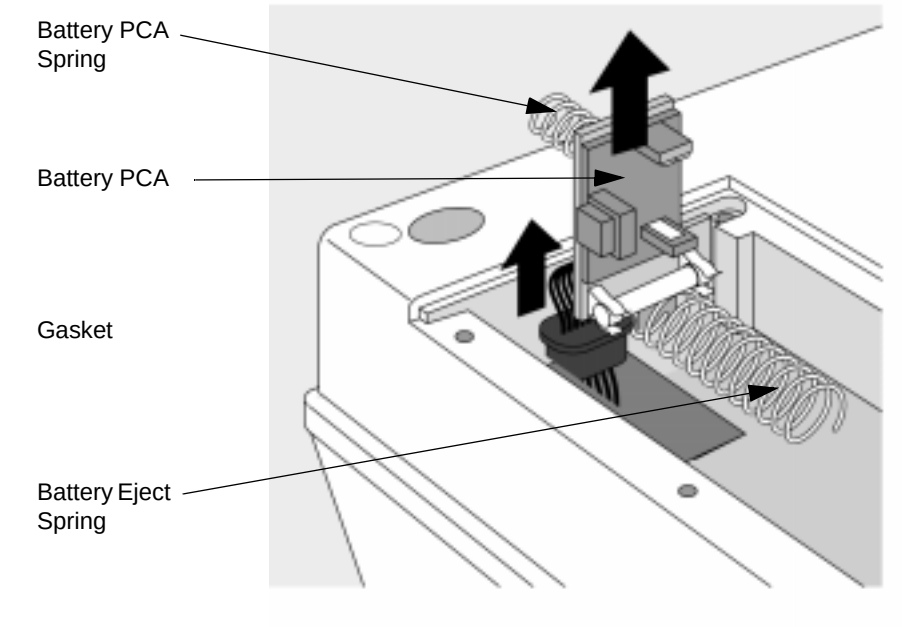


Figure 4-40 Removing the Battery PCA



Replacement

1. **Insert the wires and gasket into the case.**

   a. Start with the 2 halves of the case mated together. Turn the unit over so the bottom faces up.

   a. Guide the wires and connectors from the new PCA into the hole in the bottom case.

   b. Install the new gasket into the hole.

   TIP: The gasket is fully seated when its tabs protrude out evenly around the hole on the inside of the case.

2. **Replace the Battery PCA into position.**

   a. Install the Battery Plate Spring onto the standoff on the Battery PCA.

   b. Install the Battery PCA into its slot in the case.

3. **Flip the case over and plug in the 3 connectors.**

   a. Turn the case over so the top faces up

   b. Open the case.

   c. Plug the 4 pin connector onto the Power PCA (the battery connector).

   d. Plug the 2 pin connector onto the Power PCA.

   e. Plug the 2 pin connector into the AC Power Module.

After Repair

After this repair is complete, perform the following steps.

1. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

2. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Defibrillator Capacitor

WARNING

Always discharge the defibrillator capacitor before performing any service operations on this unit. See "Separate the Case" on page 4-26.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after repair.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Lift the capacitor out of the way.**

   Lift up the defibrillator capacitor and its foam base. Lift straight up, then turn and rest them on the Power PCA. See Figure 4-41 on page 4-85.

2. **Disconnect the capacitor.**

   a. Before disconnecting the capacitor, note the polarity and routing of its 2 wires - the red wire to the spade connector next to the red inductor, and the white wire to the spade up in the corner of the Power PCA.

   b. Unplug the defibrillator capacitor from the Power PCA by pulling straight up on its spade connectors with needle nose pliers. Take care to not stress the wires.

3. **Remove the capacitor.**

   a. Slide the wires out through the hole in the foam base.

   b. Using a clip lead, short the capacitor's terminals together to prevent charge accumulation and lay the defibrillator capacitor aside.

Replacement

1. **Replace the capacitor.**

   a. The new capacitor will come with a shorting bar connecting the two terminals. Disconnect the shorting bar.

   b. Slide the wires through the large hole in the foam base.

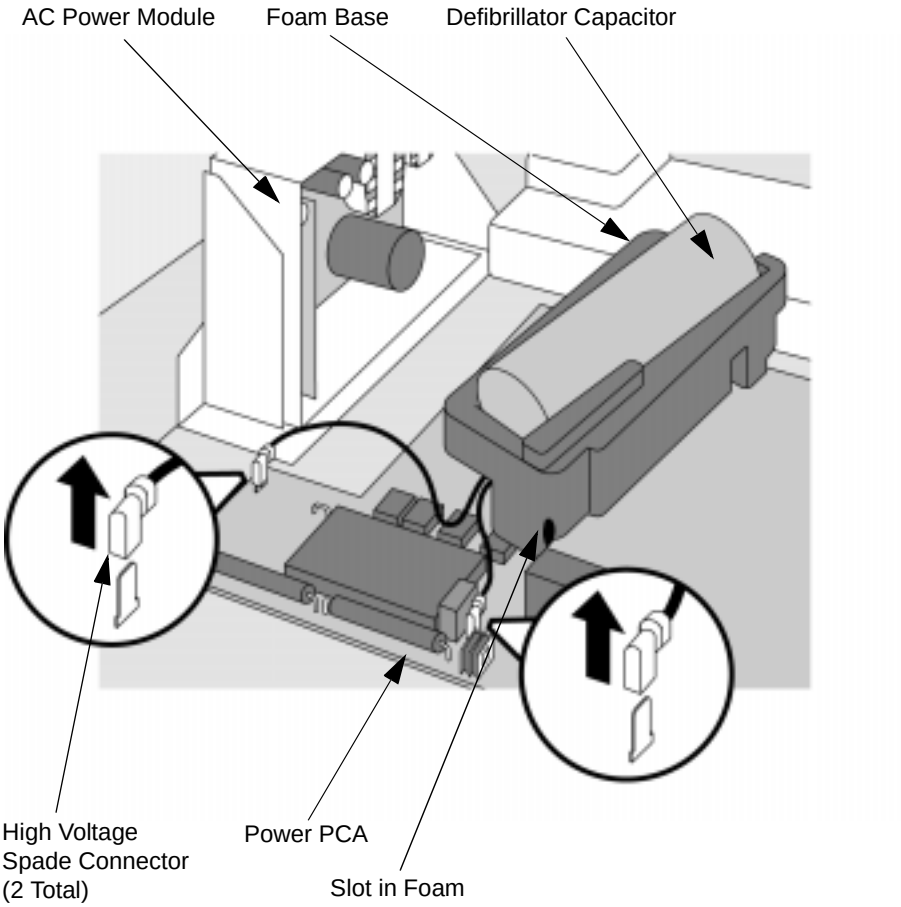
2. **Connect the capacitor.**
   Plug the terminals onto the spade connectors on the Power PCA. Orient the wires so they point toward the center of the Power PCA, as shown in Figure 4-41.

NOTE

The correct polarity is with the red wire near the red inductor and the white wire near the back corner of the Power PCA.

3. **Restore the capacitor to its final position.**
   a. Pivot the capacitor around to the left.
   b. Guide the white wire through the slot in the foam base.
   c. Lower the foam base onto the Power PCA.

Figure 4-41 Disconnecting the Capacitor



After Repair

After this repair is complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

2. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Power PCA

The Power PCA is located in the bottom case.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

3. **Disconnect and remove the defibrillator capacitor.**

   See "Defibrillator Capacitor" on page 4-84.

Removal

1. **Disconnect the Patient Connector from the Power PCA.**

   a. Disconnect the 9 pin connector; press on the latch to release. See Figure 4-42 on page 4-87.

   b. Disconnect the 2 High Voltage spade connectors by pulling up with a needle nose pliers.

2. **Disconnect the Battery PCA from the Power PCA.**

   a. Disconnect the large white 4-pin connector; press on the latch to release. This connector carries the battery leads (2 red + 2 black wires).

   b. Disconnect the small 2-pin connector; press on the latch to release.

3. **Disconnect the AC Power Module.**

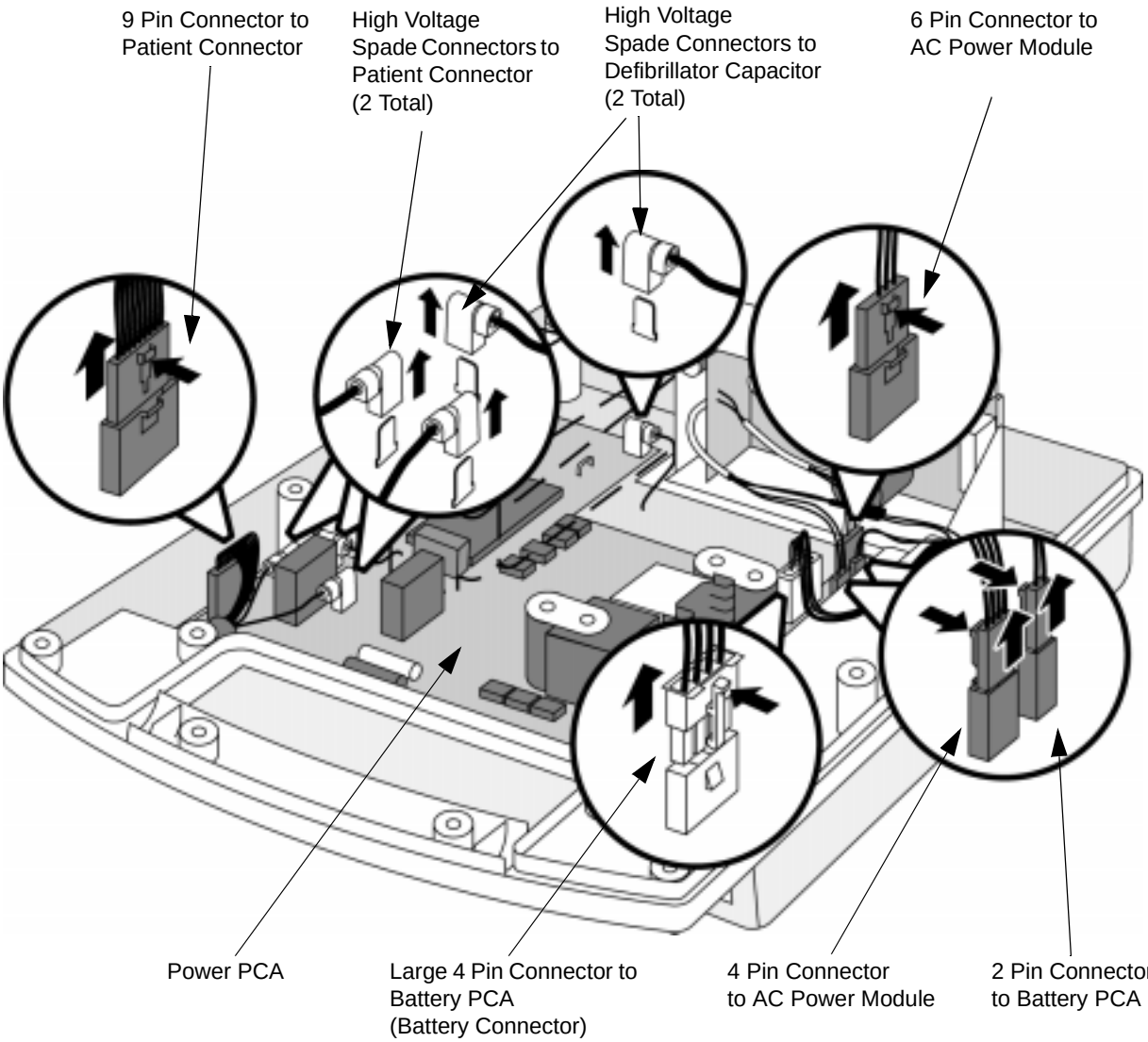
   a. Disconnect the 6 pin connector from the Power PCA; press on the latch to release. Note it only carries 3 wires.

   b. Disconnect the 4 pin connector from the Power PCA; press on the latch to release.

4. **Disconnect the Control PCA ribbon cable.**

   Disconnect the large ribbon cable from the Control PCA. Its other end should already be disconnected from the Control PCA.

Figure 4-42 Disconnecting the Power PCA


9 Pin Connector to Patient Connector
High Voltage Spade Connectors to Patient Connector (2 Total)
High Voltage Spade Connectors to Defibrillator Capacitor (2 Total)
6 Pin Connector to AC Power Module
Power PCA
Large 4 Pin Connector to Battery PCA (Battery Connector)
4 Pin Connector to AC Power Module
2 Pin Connector to Battery PCA

5. **Remove the Power PCA.**

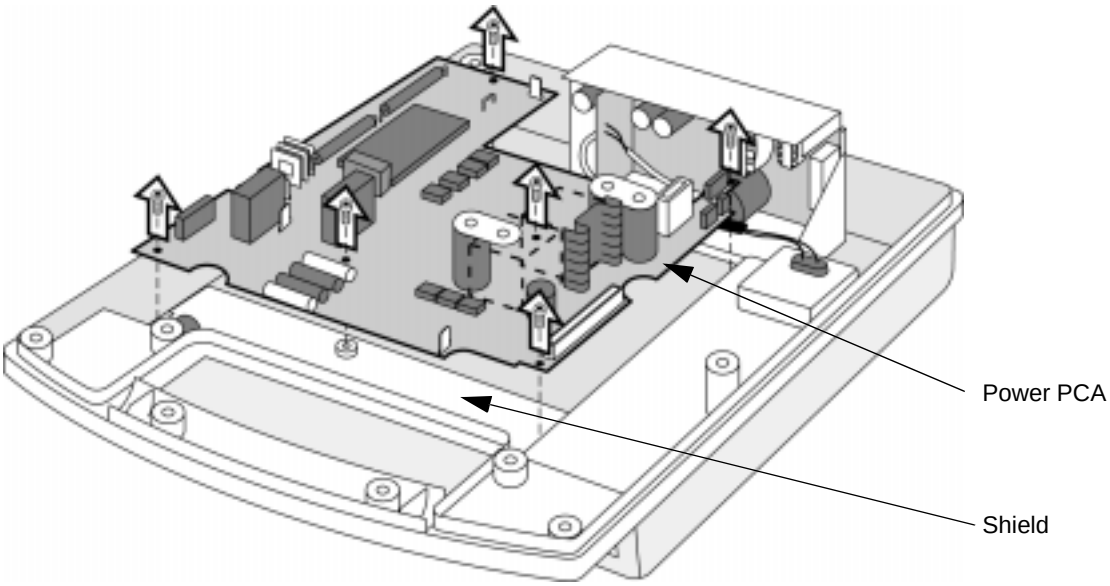
   a. Remove the 6 T10 size screws from the Power PCA.

   b. Pull the Power PCA up and guide it around the Patient Connector and the case post.

   TIP: Lift the back edge of the PCA (nearest the AC Power Module) first. Then guide the PCA out to the right to clear the Patient Connector and the case post, and lift the PCA clear of the case.

WARNING **Leave the shield in place in the bottom case, under the Power PCA. Be careful not to cut or puncture the shield.**

Figure 4-43 Removing he Power PCA



Replacement

1. **Replace the Power PCA.**

   a. Ensure the shield is still in its proper position in the bottom case.

   a. Guide the Power PCA into position under the Patient Connector.

   b. Replace the 6 T10 screws and tighten. See Figure 4-42 on page 4-87.

2. **Connect the Control PCA ribbon cable.**

   Connect the large ribbon cable. Its other end will still be disconnected from the Control PCA.

3. **Connect the AC Power Module.**

   a. Connect the 2 pin in-line connector to the Battery PCA; be sure it latches.

   b. Connect the 6 pin connector to the Power PCA; be sure it latches.

   c. Connect the 4 pin connector to the Power PCA; be sure it latches.

4. **Connect the Battery PCA to the Power PCA.**

   a. Connect the 4 pin connector; be sure it latches.

   b. Connect the small 2-pin connector; be sure it latches.

5. **Connect the Patient Connector to the Power PCA.**

   a. Connect the 9 pin connector; be sure it latches.

   b. Connect the 2 High Voltage spade connectors by pushing straight down with a needle nose pliers.

After Repair

After this repair is complete, perform the following steps.

1. **Connect and replace the defibrillator capacitor.**

   See "Defibrillator Capacitor" on page 4-84.

2. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

3. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

4. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

AC Power Module

The following sections describe how to remove and replace the AC Power Module.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Remove the screws.**

   a. Orient the M4735A so the end of the bottom case is hanging off the work surface. See Figure 4-45.

   b. Remove the 2 T15 screws that secure the AC Power Module.

   TIP: Another way to remove the screws is to mate the case halves together, flip the case upside down, then remove the screws. Then flip the case rightside up and unmate the case halves..

2. **Disconnect the AC Power Module.**

   a. Disconnect the 2 pin in-line connector from the Battery PCA; press on the latch to release.

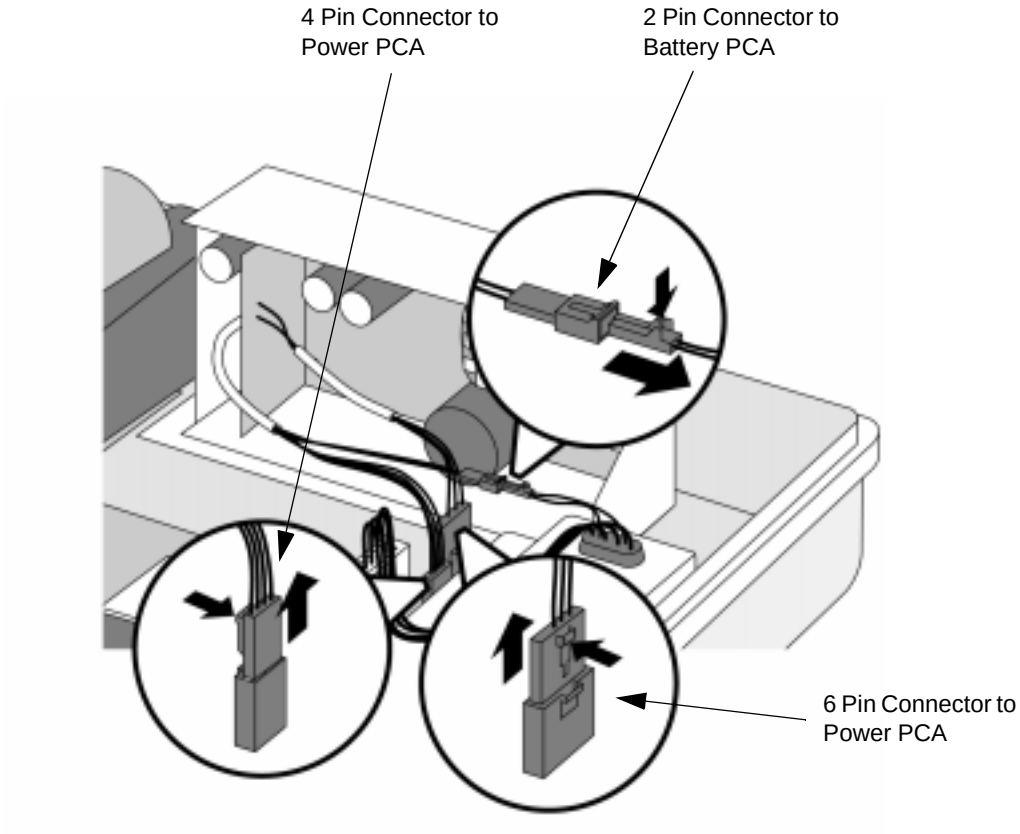
   b. Disconnect the 6 pin connector from the Power PCA; press on the latch to release.

   c. Disconnect the 4 pin connector from the Power PCA; press on the latch to release.

3. **Lift the Defibrillator Capacitor out of the way.**

   Lift up the Defibrillator Capacitor together with its foam base. Lift straight up, then turn the capacitor to the right and rest it on the Power PCA. See Figure 4-41 on page 4-85.

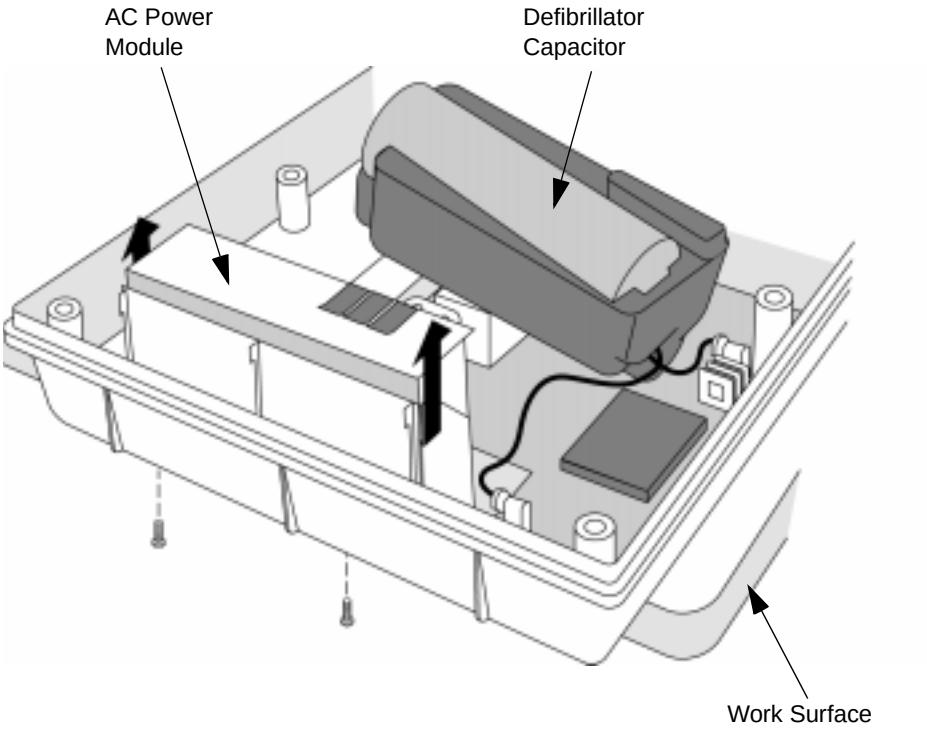
Figure 4-44 AC Power Module Connections



4. **Remove the AC Power Module.**

   Tilt the top of the AC Power Module in toward the Power PCA. Guide the AC Power Module out from under the end of the Power PCA, then lift it out of the case.

Figure 4-45 Removing the AC Power Module



Replacement

1. **Replace the AC Power Module.**

   a. Guide the bottom of the AC Power module into place under the Power PCA, aligning the notch in the plastic frame with the tab on the PCA.

   b. Press the Power Module down into position. Be sure it aligns correctly with the raised screw holes in the bottom case.

2. **Connect the AC Power Module.**

   a. Connect the 2 pin in-line connector to the Battery PCA; be sure it latches.

   b. Connect the 6 pin connector to the Power PCA; be sure it latches.

   c. Connect the 4 pin connector to the Power PCA; be sure it latches.

3. **Replace the Defibrillator Capacitor**

   Restore the Defibrillator Capacitor to its original position on the Power PCA.

4. **Replace the screws.**

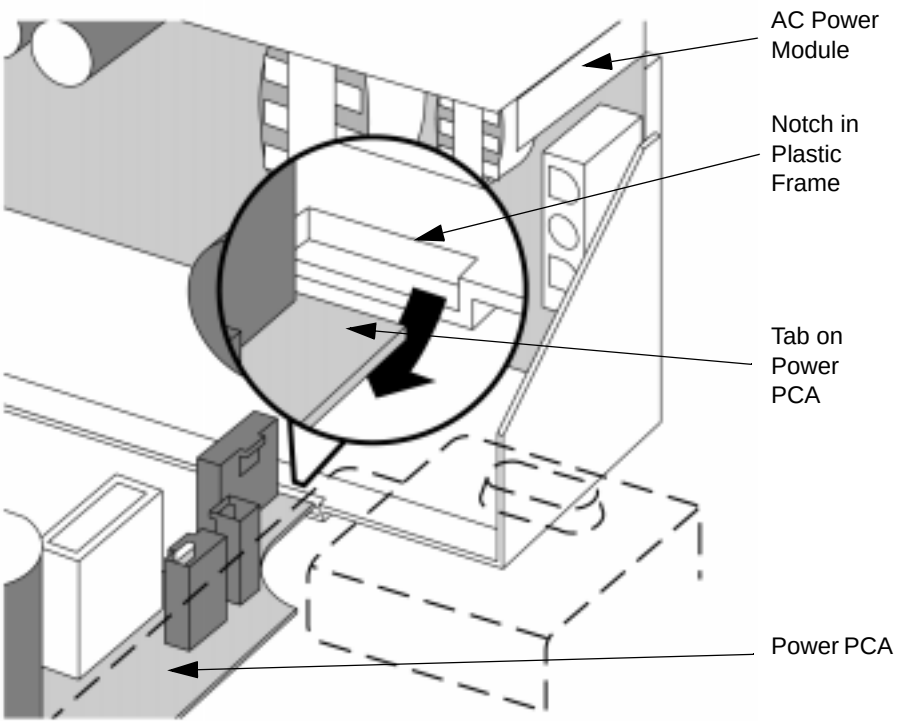
   a. Mate the 2 case halves together.

   b. Flip the unit over bottom side up.

   c. Replace the 2 T15 screws and tighten.

   d. Flip the unit rightside up and unmate the case halves.

Figure 4-46 Replacing the AC Power Module



After Repair

After repairs are complete, perform the following steps.

5. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

6. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

7. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Patient Connector

The following sections describe how to remove and replace the Patient Connector. The Patient Connector is where the paddles or the pads cable connect to the M4735A.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

Removal

1. **Disconnect the Patient Connector from the Power PCA.**

   a. Disconnect the 9 pin connector; press on the latch to release. See Figure 4-42 on page 4-87.

   b. Disconnect the 2 High Voltage spade connectors by pulling up with a needle nose pliers. Note they are different sizes.

2. **Remove the Patient Connector.**

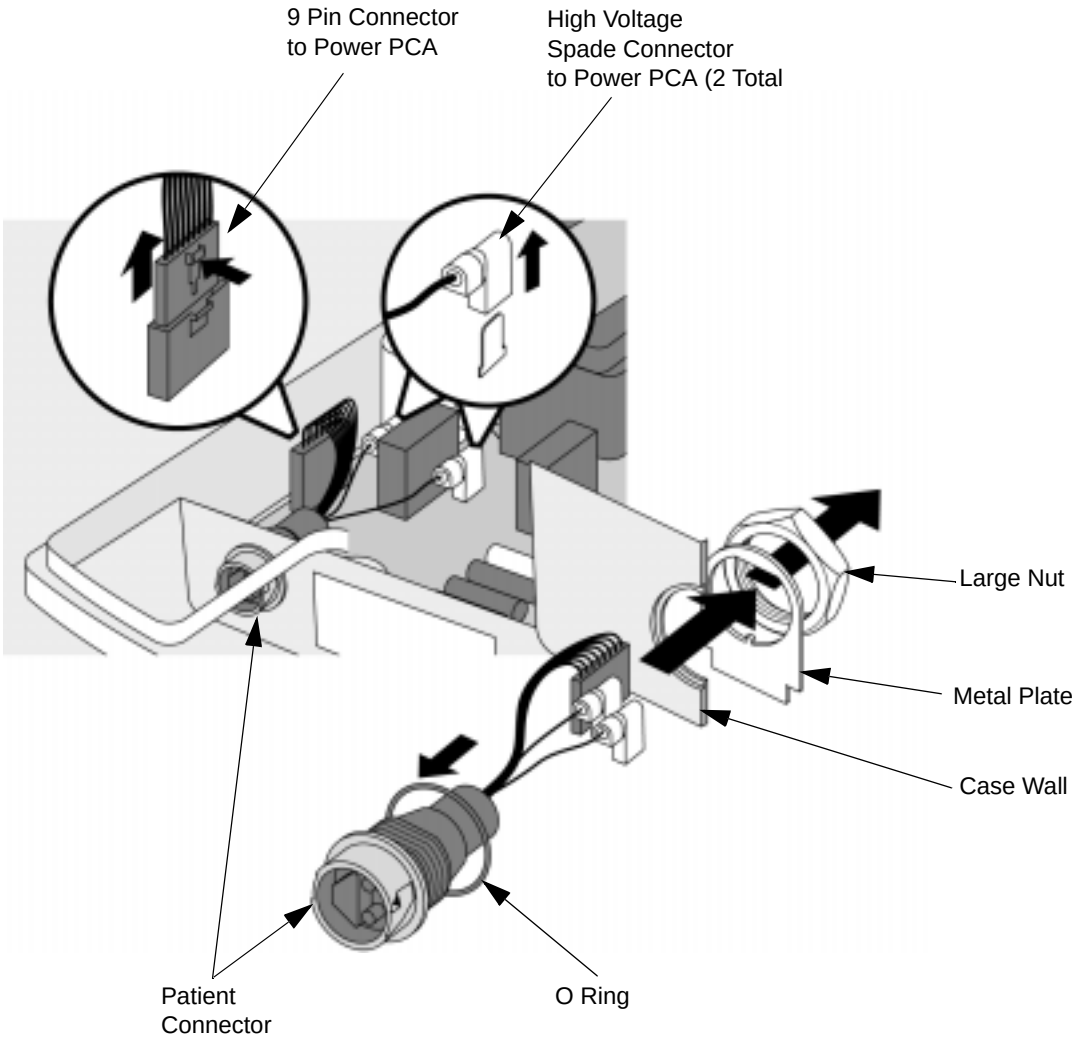
   a. Unscrew the large nut on the back of the connector using a wrench or pliers.

   b. Pull the connector and its wires and O-ring out of the case.

   TIP: Turn the 9 pin connector sideways to guide it out through the nut and through the hole in the case.

   c. Leave the metal plate in place on the inside of the hole.

Figure 4-47 Removing the Patient Connector



Replacement

1. **Replace the Patient Connector.**

   a. Slide the wires of the new connector through the new O-ring that came with the connector. Seat the O-ring on the connector.

   b. Insert the wires through the hole in the case, and then through the metal plate. Finally, guide them though the large nut. Use the existing nut and plate.

   c. Align the flat section on the connector with the flat portion of the case hole.

   d. Push the connector into the hole, seating the O-ring into the recess in the case.

   e. Tighten the large nut snugly but not excessively - the goal is to compress the O-ring, not crush it hard against the case.

2. **Connect the Patient Connector to the Power PCA.**

   a. Connect the 9 pin connector; be sure it latches.

   b. Connect the 2 High Voltage spade connectors by pushing straight down with a needle nose pliers.

After Repair

After repairs are complete, perform the following steps.

1. **Reassemble the case.**

   See "Closing the Case" on page 4-99.

2. **Restore the customer’s configuration.**

   Enter Configuration Mode and reload the customer’s configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

3. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Replacement Bottom Case

The following sections describe how to remove and replace the Bottom Case Assembly.

Description

The Bottom Case Assembly consists of the following components, all preassembled into the case at the factory.

- Data Card Door.
- Battery Eject Latch mechanism
- Case gasket.
- Plug and O-ring for the hole in the front of the case.
- Rubber feet on the bottom.

Preparation

1. **Save the configuration.**

   If possible, save the customer's configuration onto a Data Card (or print the configuration) so the configuration can be restored after the repair is complete.

2. **Open the case safely.**

   See "Opening the Case" on page 4-24.

   - Data Card Door gasket.

Removal and replacement

The Bottom Case replacement involves:

- Several existing parts which need to be moved from the old case to the new.
- Several new parts which must be installed, and
  - some come with the bottom case.
  - some must be ordered separately.

Parts to be moved from old bottom case to new

The following subassemblies must be removed from the old bottom case and installed into the new one. Follow the Removal and Replacement instructions in this chapter for each subassembly. Remove them in the order shown, and replace them in reverse order.

1. Battery PCA, spring, cable (see"Battery PCA" on page 4-80).
2. Battery eject spring (see "Battery PCA" on page 4-80).
3. Patient Connector, cables, hardware (see "Patient Connector" on page 4-94).
4. Defibrillator capacitor (see "Defibrillator Capacitor" on page 4-84).

5. Power PCA and shield (see "Power PCA" on page 4-86).
6. AC Power Module (see "AC Power Module" on page 4-90).
7. Battery.
8. All screws.

New parts to be installed - provided with bottom case

The Replacement Bottom Case Assembly comes with the following new components, which must be installed in the field.

- Battery cover.
- Large nut (for Patient Connector).

New parts to be installed - must be ordered separately

In addition, the following parts cannot be reused from the old case, and must be ordered separately and installed into the new bottom case:

- Case Label Set

  These are available in all the supported languages. See the "Replacement Parts" chapter, 5-11 to select the correct language.

- Primary Label

  When replacing the bottom case, the Primary Label containing the unit's serial number must also be replaced. Be prepared to provide information identifying the unit when ordering the bottom case.

NOTE

To enable device tracking as mandated by US Federal law, the Primary Label must be applied before placing the unit back into service.

After Repair

After repairs are complete, perform the following steps.

1. **Restore the customer's configuration.**

   Enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

2. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

Closing the Case

To close the case:

1. **Recheck connections.**

   Recheck connections to all PCAs. Be sure all connectors are fully seated and latched.

2. **Make the unit ready for assembly.**

   a. Make sure the Data Card ejector button is pressed in fully.

   b. Orient the unit flat on a smooth surface so that the handle is closest to you, with the bottom case on the left next to the top case. See Figure 4-17 on page 4-29.

   c. Pivot the top case to a vertical position as shown in Figure 4-16.

3. **Connect the case halves.**

   a. Connect the large ribbon cable from the Power PCA to the Control PCA.

   b. Connect the single wire from the Keyscan PCA to the Power PCA. Push straight down with needle nose pliers.

   c. Connect the AC input to the AC Power Module by pushing the connector straight into the Module.

4. **Mate the case halves.**

   a. Flip the top case over to the left into a rightside-up position over the bottom case.

   b. Lower the top case straight down, with the front edge first to give extra room for the ejector button.

   c. Mate top to bottom.

5. **Check the unit.**

   a. Carefully check around all mating edges of the case for any gasket, wires, etc., sticking out between the case halves.

   b. Turn the case upside down (holding the halves together with your hands) and shake it to double check for loose hardware inside.

   c. Look into the screw holes at the back corners of the case (where the tall case posts are located). Check that the post screw holes line up with the screw holes in the case.

6. **Replace the case screws.**

   a. Place the unit on the work surface upside down.

   b. Replace the 1 T15 case screw located in the battery compartment.

c. Replace the Battery Cover as described in "Battery Cover" on page 4-10.

d. Turn the unit over rightside up.

e. Install a battery. If the battery does not readily latch into place, check for a case screw or other hardware lodged against the Battery PCA. Also check that the Battery PCA is installed correctly.

f. Turn on power and run an Extended Self Test before installing the rest of the case screws (see "Extended Self Test" on page 2-22).

g. Remove the battery.

h. Turn the case over and replace the remaining 9 Torx T15 screws in their holes and tighten snugly.

7. **Restore the customer's configuration.**

   If you have not already done so, enter Configuration Mode and reload the customer's configuration from the data card, or reconfigure the unit. See "Configuration Mode" on page 2-10.

8. **Test performance.**

   Conduct Performance Verification Testing as described in "Performance Verification and Safety Tests" starting on page 2-1.

5 Replacement Parts

Overview

This chapter provides the part numbers for all replaceable assemblies and sub-assemblies.

Chapter Contents

The major sections of this chapter are as follows:

Section	*Page*
Ordering Replacement Parts	5-1
Ordering Supplies and Accessories	5-1
Key Components	5-2
Calling for Service	5-3
Special Tools	5-4
M4735A Unit Exchange Program	5-5
Replacement Parts Tables	5-6

Ordering Replacement Parts

To order replacement parts:

- In the US, call **800-227-8164.**
- Outside the US, contact your local Agilent Technologies office.

Ordering Supplies and Accessories

To order accessories and supplies:

- Visit our Medical Supplies website at: www.healthcare.agilent.com/mpgsupplies/.
- In the US, call **800-225-0230.**
- Outside the US, contact your local Agilent Technologies Sales Office, or your authorized Agilent Technologies Dealer or Distributor.

Key Components

Replacement assemblies marked with an asterisk (" ***** ") contain one or more Key Components. Key Components require detailed tracking, by recording the key component part number and either the key component's date code or its serial number. This data must be recorded for both the failed assembly and the replacement assembly.

Agilent Technologies service personnel must record this information on the Customer Service Order (CSO).

The Key Components that are part of the replacement assemblies are listed in Table 5-17 on page 5-21.

Calling for Service

For assistance call the Response Center nearest to you, or visit our website at: www.agilent.com/healthcare.

United States of America

Medical Response Center	Tel: (800) 548-8833

Canada

Eastern Region	Central & Western Regions
Tel: (800) 361-9790	Tel: (800) 268-1221

Other International Areas

Australia	France
Tel: 131147	Tel: 0803 35 34 33

Germany	Italy
Tel: 0130-4730	Tel: 0292 122999

Netherlands	United Kingdom
Tel: (0) 20-547-6333	Tel: 44-344-36633

Belgium	
Tel: 32 2 778 35 31	

Special Tools

The following special tools are available for purchase from Agilent Technologies at the replacement parts numbers given above.

Tool	Part Number
• Torx driver kit	• 5181-1933
• High voltage discharge tool	• M2475-69572
• Software Support Tool	• M4735-87890

M4735A Unit Exchange Program

For customers taking advantage of the M4735A Unit Exchange program, the following are notes on logistics and a list of the available Exchange Units.

Logistics

- Agilent ships a replacement unit to the customer. This unit does NOT include paddles, cables, sensors, accessories, battery, data card, or consumables.
- Customer takes the exchange unit out of the box, tests it, and puts it into service.
- Customer removes all paddles, cables, sensors, accessories, battery, data card, and consumables from defective unit.
- Customer cleans and decontaminates the defective unit.
- Customer packs the defective unit into the box and ships it to Agilent. Return shipping instructions are included with the exchange unit.

Table 5-1 M4735A Unit Exchange Part Numbers

Description	Part Number
M4735A Base Unit - American English	M4735-68900
M4735A Base Unit - French	M4735-68901
M4735A Base Unit w/Pacing - American English	M4735-68910
M4735A Base Unit w/Pacing - French	M4735-68911
M4735A Base Unit w/SpO_2 - American English	M4735-68920
M4735A Base Unit w/SpO_2 - French	M4735-68921
M4735A Base Unit w/SpO_2 and Pacing - American English	M4735-68930
M4735A Base Unit w/SpO_2 and Pacing - French	M4735-68931

Replacement Parts Tables

These tables provide part numbers for ordering specific replacement assemblies and parts.

Electrical Assemblies	**Page**
Control PCA	5-7
Other Replacement PCAs	5-8
Other Electrical Assemblies	5-8
Individual Electrical Parts	5-9
Mechanical Assemblies	**Page**
Bezel Assembly	5-10
Pacer Keypad Assembly	5-11
Other Mechanical Assemblies	5-12
Connector Assemblies	5-12
Individual Mechanical Parts	5-13
Instruction Label Sets	5-14
Case Label Sets	5-16
Other Labels	5-17
Supplies and Accessories	**Page**
Supplies & Accessories	5-18
Key Components	**Page**
Key Components	5-21

Electrical Assemblies

The following tables provide information about replacement electrical assemblies.

Control PCA

The replacement Control PCA includes the Lithium backup battery, the battery's cable tie wrap, and the black plastic shield for the Data Card receptacle entrance. Installation requires use of the Support Software Tool (M4735-87890).

Table 5-2 Replacement Control PCA

Language	Part Number
American English	M4735-68100 *
French	M4735-68101 *
German	M4735-68102 *
Dutch	M4735-68103 *
Spanish	M4735-68104 *
Italian	M4735-68105 *
Swedish	M4735-68106 *
Norwegian	M4735-68108 *
Finnish	M4735-68109 *
Portuguese	M4735-68113 *
Russian	M4735-68114 *
Polish	M4735-68119 *
British English	M4735-68160 *
Chinese	M4735-68161 *
Australian English	M4735-68170 *

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Other Replacement PCAs

These PCAs come with specific parts as noted.

Table 5-3 Other Replacement PCAs

Description	Part Number	Notes
Power PCA with Pacing	M4735-68110 *	
Power PCA without Pacing	M4735-68111 *	
Keyscan PCA	M4735-68120 *	
SpO_2 PCA	M4735-68126 *	
Parameter PCA	M4735-68140 *	Includes standoffs for SpO_2 PCA.
Battery PCA	M3500-66130 *	Includes spring, cables, Main Fuse.

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Other Electrical Assemblies

These assemblies come with specific parts as noted.

Table 5-4 Other Electrical Assemblies

Description	Part Number	Notes
Printer Assembly	M4735-69520	
Display Assembly	M4735-69552 *	
Defibrillator Capacitor Assembly	M3500-69564 *	
Speaker Assembly	M3500-69552	Includes speaker, cable.
AC Power Module	M4735-66020 *	
Energy Select Switch Assembly	M4735-69564 *	

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Individual Electrical Parts

These electrical parts are available separately.

Table 5-5 Individual Electrical Parts

Description	Part Number	Notes
Lithium Backup Battery	1420-0341	*Also order cable tie wrap (Table 5-10) to secure to Control PCA.*
Main Fuse (25A, 32V)	2110-0250	Pkg. of 5

Mechanical Assemblies

The following tables provide information about replacement mechanical assemblies.

Bezel Assembly

The Bezel Assembly comes with the Main Keypad and the display window installed.

Table 5-6 Replacement Bezel Assembly

Language	Part Number
English	M4735-69400 *
French	M4735-69401 *
German	M4735-69402 *
Dutch	M4735-69403 *
Spanish	M4735-69404 *
Italian	M4735-69405 *
Swedish	M4735-69406 *
Norwegian	M4735-69408 *
Finnish	M4735-69409 *
Chinese	M4735-69411 *
Portuguese	M4735-69413 *
Russian	M4735-69414 *
Polish	M4735-69419 *

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Pacer Keypad Assembly

Each assembly below contains both the membrane switches and the rubber overlay.

Table 5-7 Replacement Pacer Keypad Assembly

Language	Part Number
English	M4735-69500 *
French	M4735-69501 *
German	M4735-69502 *
Dutch	M4735-69503 *
Spanish	M4735-69504 *
Italian	M4735-69505 *
Swedish	M4735-69506 *
Norwegian	M4735-69508 *
Finnish	M4735-69509 *
Chinese	M4735-69511 *
Portuguese	M4735-69513 *
Russian	M4735-69514 *
Polish	M4735-69519 *
Replacement Blank Pacer Cover (Rubber overlay only - for units without Pacing)	M4735-69540

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Other Mechanical Assemblies

These assemblies come with specific parts as noted.

Table 5-8 Other Mechanical Assemblies

Description	Part Number	Notes
Data Card Door Assembly	M4735-69560	Includes door, latch, pivot/spring assembly.
Paddle Holder Assembly	M4735-69561	Includes plastic retainer, metal clip, screws.
Battery Eject Assembly	M3500-69561	Includes catch, button, spring.
Top Case Assembly	M4735-69551	Includes Speaker Label, Branding Label, Hex Standoffs (for Keyscan PCA), Case Standoffs, Printer cable, IRDA lens; and ECG/SpO_2 hole plug, retainer clips, and gaskets.
Bottom Case Assembly	M4735-69550	Includes Data Card Door, Battery Cover, Battery Eject Mechanism, Hole Plug with gasket, case gaskets, rubber feet.
Note: When ordering the Bottom Case, be sure to order the Primary Label as well. When ordering, be prepared to provide information from the existing label (model number, serial number, options), plus customer information (name and address), and information identifying the service person (name, address).		

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Connector Assemblies

These replacement connectors come with specific parts as noted.

Table 5-9 Replacement Connector Assemblies

Description	Part Number	Notes
ECG Connector Assembly	M4735-69553	Includes connector, gasket, retainer clip, cable and ferrite.
SpO_2 Connector Assembly	M4735-69554	Includes connector, gasket, flex cable, retainer clip.
Patient Connector Assembly	M3500-69562 *	Includes connector, O-ring, internal cables.
ECG Out/AC Input Assembly	M4735-69563	Includes ECG Out connector, AC Input receptacle, cables.

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Individual Mechanical Parts

These mechanical parts are available separately.

Table 5-10 Individual Mechanical Parts

Description	Part Number	Notes
Cable Tie Wrap	1400-0577	Used to secure Lithium Battery to Control PCA.
ECG/SpO_2 Connector Retainer Clip	M2475-07101	Used on both ECG and SpO_2 connectors.
T10 (M3X4) screws	0515-0663	Used only inside the case to connect the paddle wires from the Keyscan PCA to the through-case connection to the Paddle Clip.
T10 (M3X6) screws	0515-0430	Used for battery cover, interior assemblies, PCAs. Also used outside the case to connect the Paddle Clip to the through-case connection to the Keyscan PCA.
T10 (M3X20) screws	0515-1410	Long screws used for securing Parameter PCA to top case. If SpO_2 installed, secures SpO_2 PCA to Parameter PCA.
T15 (M4) flat head screws	0515-2044	Used only for securing paddle holder to case.
T15 (M4X10) screws	0515-0380	Used for case exterior.
Rubber Feet	M4735-69562	Includes 4 feet.
Energy Select Knob	M4735-69565	

*Items marked with an asterisk (" * ") contain Key Components which require tracking. See Table 5-17 on page 5-21.*

Labels

The labels used on the M4735A are divided into 4 groups: the Instruction Label Set, the Case Label Set, the Branding Label Set, and the Speaker Label. Each set of labels is one sheet containing all the labels in that set.

For details of which label is part of which set, see "Labels" on page 4-20.

Instruction Label Sets

The Instruction Label Set is available for units both with and without pacing, in the following supported languages. See Figure 4-10 on page 4-21 for correct placement of these labels.

Table 5-11 Instruction Label Sets - *Without* Pacing

Language	Part Number
English	M4735-69600
French	M4735-69601
German	M4735-69602
Dutch	M4735-69603
Spanish	M4735-69604
Italian	M4735-69605
Swedish	M4735-69606
Norwegian	M4735-69608
Finnish	M4735-69609
Chinese	M4735-69611
Portuguese	M4735-69613
Russian	M4735-69614
Polish	M4735-69619

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Table 5-12 Instruction Label Sets - *With* Pacing

Language	Part Number
English	M4735-69700
French	M4735-69701
German	M4735-69702
Dutch	M4735-69703
Spanish	M4735-69704
Italian	M4735-69705
Swedish	M4735-69706
Norwegian	M4735-69708
Finnish	M4735-69709
Chinese	M4735-69711
Portuguese	M4735-69713
Russian	M4735-69714
Polish	M4735-69719

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Case Label Sets

The Case Label Set is available for units both with and without SpO_2, in the following supported languages. See Figure 4-10 on page 4-21 for correct placement of these labels.

Table 5-13 Case Label Sets - *Without* SpO_2

Language	Part Number
English	M4735-69800
French	M4735-69801
German	M4735-69802
Dutch	M4735-69803
Spanish	M4735-69804
Italian	M4735-69805
Swedish	M4735-69806
Norwegian	M4735-69808
Finnish	M4735-69809
Chinese	M4735-69811
Portuguese	M4735-69813
Russian	M4735-69814
Polish	M4735-69819

Table 5-14 Case Label Sets - *With* SpO_2

Language	Part Number
English	M4735-69820
French	M4735-69821
German	M4735-69822
Dutch	M4735-69823
Spanish	M4735-69824
Italian	M4735-69825
Swedish	M4735-69826
Norwegian	M4735-69828
Finnish	M4735-69829
Chinese	M4735-69831
Portuguese	M4735-69833
Russian	M4735-69834
Polish	M4735-69839

*Items marked with an asterisk (" * ") contain Key Components which require tracking. See Table 5-17 on page 5-21.*

Other Labels

These labels are also available. See Figure 4-12 on page 4-22 for correct placement of these labels.

Table 5-15 Other Labels

Description	Part Number	Notes
Speaker Label Set	M4735-69555	
Branding Label Set	M4735-69556	

*Items marked with an asterisk (" * ") contain Key Components which require tracking. See Table 5-17 on page 5-21.*

Supplies & Accessories

Approved supplies and accessories for the M4735A are listed in Table 5-16. To order accessories and supplies:

- Visit our Medical Supplies website at: www.healthcare.agilent.com/mpgsupplies/.
- In the US, call **800-225-0230.**
- Outside the US, contact your local Agilent Technologies Sales Office, or your authorized Agilent Technologies Dealer or Distributor.

Table 5-16 Supplies and Accessories

Part Number	Description
Paper	
40457C	1 box (10 rolls) of 50 mm strip printer paper.
40457D	1 case (80 rolls) of 50 mm strip printer paper.
External Defibrillation Paddles	
M4745A *	External Sterilizable Paddles (includes M1789, below).
M4746A *	External Paddles with PCI (includes M1789A, below).
M1789A	Replacement Adult Paddle Adapter - slip on.
Internal Defibrillation Paddles	
M1741A *	7.5 cm Switchless Internal Paddles
M1742A *	6.5 cm Switchless Internal Paddles
M1743A *	4.5 cm Switchless Internal Paddles
M1744A *	2.8 cm Switchless Internal Paddles
M4741A *	7.5 cm Switched Internal Paddles
M4742A *	6.5 cm Switched Internal Paddles
M4743A *	4.5 cm Switched Internal Paddles
M4744A *	2.8 cm Switched Internal Paddles
M4740A *	Internal Paddles Adapter Cable

Part Number	Description
Defibrillation Pads	
M3501A	Adult multi-function defib electrodes, AAMI.
M3502A	Adult multi-function defib electrodes, IEC.
M3503A	Pediatric multi-function defib electrodes, IEC.
M3504A	Pediatric multi-function defib electrodes, AAMI.
DP2	Defibrillation pads: 2 Pack Heartstream.
DP6	Defibrillation pads: 6 Pack Heartstream.
Pads Cables	
M3507A *	Agilent Pads Adapter Cable
M3508A *	Heartstream Pads Connector Cable
05-10200	Heartstream Pads Adapter for DP2 and DP6 Pads (use with M3507A)
ECG Monitoring Electrodes	
M2202A	Case of monitoring electrodes.
ECG Monitoring Cables and Leadsets	
M1500A	3-lead ECG Trunk Cable, AAMI
M1605A	3-lead ECG Leadset with Snaps, AAMI
M1510A	3-lead ECG Trunk Cable, IEC
M1615A	3-lead ECG Leadset with Snaps, IEC
M1520A	5-lead ECG Trunk Cable, AAMI
M1625A	5-lead ECG Leadset with Snaps, AAMI
M1530A	5-lead ECG Trunk Cable, IEC
M1635A	5-lead ECG Leadset with Snaps, IEC
SpO_2 Cable/Sensors	
M1191A	Adult Finger Glove Reusable SpO_2 Sensor.
M1192A	Pediatric/Small Adult Finger Glove, Reusable SpO_2 Sensor.
M1194A	Ear Clip Reusable SpO_2 Sensor.
M1943A	Nellcor SpO_2 Adapter Cable.
Data Card	
M3510A	Data Card.

Part Number	Description
Battery/ Charger	
M3516A *	Sealed Lead Acid Battery.
M4747A *	Battery Charger Kit. (Includes Battery Charger Adapter, External AC Power Module, and Battery)
Test Load	
M1781A	Defibrillator test load.
Sync Cable	
M1783A	Sync Cable (For Synchronized Cardioversion with an External Patient Monitor)

*Items marked with an asterisk (" * ") contain Key Components which require tracking.* *See Table 5-17 on page 5-21.*

Key Components

Key components require tracking as indicated below. Record the Part Number and either the Date Code or Serial Number for both the failed component and the replacement component.

Table 5-17 Key Components

Replacement Assembly		Key Component		
Description	**Part Number**	**Description**	**Part Number**	**Tracking Method**
ELECTRICAL ASSEMBLIES				
Control PCA		Control PCA	M4735-61100	Serial Number
American English	M4735-68100 *			
French	M4735-68101 *			
German	M4735-68102 *			
Dutch	M4735-68103 *			
Spanish	M4735-68104 *			
Italian	M4735-68105 *			
Swedish	M4735-68106 *			
Norwegian	M4735-68108 *			
Finnish	M4735-68109 *			
Portuguese	M4735-68113 *			
Russian	M4735-68114 *			
Polish	M4735-68119 *			
British English	M4735-68160 *			
Chinese	M4735-68161 *			
Australian English	M4735-68170 *			
Power PCA				
With Pacing	M4735-68110	Power PCA	M4735-61110	Serial Number
Without Pacing	M4735-68111	Power PCA	M4735-61111	Serial Number
Other Replacement PCAs				
Parameter PCA	M4735-68140	Parameter PCA	M4735-61140	Serial Number
Keyscan PCA	M4735-68120	Keyscan PCA	M4735-61120	Serial Number
SpO_2 PCA	M4735-68126	SpO_2 PCA	M3500-60126	Serial Number
Battery PCA	M3500-66130	Battery PCA	M3500-60130	Date Code

Table 5-17 Key Components

Replacement Assembly		Key Component		
Description	**Part Number**	**Description**	**Part Number**	**Tracking Method**
Other Electrical Assemblies				
Display Assembly	M4735-69552	Display Assembly	2090-0803	Serial Number
Defibrillator Capacitor Assembly	M3500-69564	Defibrillator Capacitor	010879-0004	Serial Number ***and*** Date Code
AC Power Module	M4735-66020	AC Power Module	M4735-60020	Date Code
Energy Select Switch Assembly	M4735-69564	Switch Assembly	M4735-60018	Date Code
MECHANICAL ASSEMBLIES				
Bezel Assembly		Main Keypad Switch Assembly	M4735-60200	Date Code
English	M4735-69400 *			
French	M4735-69401 *			
German	M4735-69402 *			
Dutch	M4735-69403 *			
Spanish	M4735-69404 *			
Italian	M4735-69405 *			
Swedish	M4735-69406 *			
Norwegian	M4735-69408 *			
Finnish	M4735-69409 *			
Chinese	M4735-69411 *			
Portuguese	M4735-69413 *			
Russian	M4735-69414 *			
Polish	M4735-69419 *			

Table 5-17 Key Components

Replacement Assembly		Key Component		
Description	**Part Number**	**Description**	**Part Number**	**Tracking Method**
Pacer Keypad Assembly		Pacer Keypad Switch Assembly	M4735-60210	Date Code
English	M4735-69500			
French	M4735-69501			
German	M4735-69502			
Dutch	M4735-69503			
Spanish	M4735-69504			
Italian	M4735-69505			
Swedish	M4735-69506			
Norwegian	M4735-69508			
Finnish	M4735-69509			
Chinese	M4735-69511			
Portuguese	M4735-69513			
Russian	M4735-69514			
Polish	M4735-69519			
Connectors				
Patient Connector Assembly	M3500-69562	Patient Connector Assembly	M3500-62601	Date Code
SUPPLIES & ACCESSORIES				
External Defibrillation Paddles				
External Sterilizable Paddles	M4745A	External Sterilizable Paddles	M4745A	Date Code
External Paddles with PCI	M4746A	External Paddles with PCI	M4746A	Date Code

Table 5-17 Key Components

Replacement Assembly		Key Component		
Description	**Part Number**	**Description**	**Part Number**	**Tracking Method**
Internal Defibrillation Paddles				
7.5 cm Switchless Internal Paddles	M1741A	7.5 cm Switchless Internal Paddles	M1741A	Date Code
6.5 cm Switchless Internal Paddles	M1742A	6.5 cm Switchless Internal Paddles	M1742A	Date Code
4.5 cm Switchless Internal Paddles	M1743A	4.5 cm Switchless Internal Paddles	M1743A	Date Code
2.8 cm Switchless Internal Paddles	M1744A	2.8 cm Switchless Internal Paddles	M1744A	Date Code
7.5 cm Switched Internal Paddles	M4741A	7.5 cm Switched Internal Paddles	M4741A	Date Code
6.5 cm Switched Internal Paddles	M4742A	6.5 cm Switched Internal Paddles	M4742A	Date Code
4.5 cm Switched Internal Paddles	M4743A	4.5 cm Switched Internal Paddles	M4743A	Date Code
2.8 cm Switched Internal Paddles	M4744A	2.8 cm Switched Internal Paddles	M4744A	Date Code
Internal Paddles Adapter Cable	M4740A	Internal Paddles Adapter Cable	M4740-61601	Date Code
Pads Cables				
Agilent Pads Adapter Cable	M3507A	Agilent Pads Adapter Cable	M3507A	Date Code
Heartstream Pads Connector Cable	M3508A	Heartstream Pads Connector Cable	M3508A	Date Code
Battery/Adapter				
Sealed Lead Acid Battery	M3516A	Sealed Lead Acid Battery	1420-0561	Date Code
Battery Charger Kit (Battery Charger Adapter + AC Power Module + Battery)	M4747A	Sealed Lead Acid Battery	1420-0561	Date Code
		AC Power Module	M3517-60000	Date Code

6 Theory of Operation

Overview

This chapter describes the internal operation of the M4735A. This description is at the functional-block level.

The information is presented in two ways:

- PCA Descriptions

  For each Printed Circuit Assembly (PCA), a description of the major functions performed on that PCA.

- System Functional Descriptions

  For each major system function, a description of how the signal is routed through the various PCAs.

In these descriptions, reference will be made to PCAs or features which are optional and may not be present in the unit you have. In that case, simply ignore those sections. The remaining PCA and Functional descriptions will still apply.

PCA Descriptions

The sections following provide descriptions of the functions handled by each PCA.

Control PCA

The Control PCA performs the following functions:

- System level processing.
- System level control and clock functions, including:
    a. Control of power up and power down sequences.
    b. Storage of configuration selections made by the user.
    c. Storage of operating software, including data for generating display formats and graphics.
- Main interconnection site between the other PCAs.
- User interface functions, including:
    a. Generation and control of tones and audio prompts.
    b. Generation and formatting of real-time information for the display and for the printer.
    c. Control of printer functions.
    d. Control of indicator LEDs for Manual, Sync and Pacer keys.
- Control of data to and from the Data Card.
- Control of defibrillation functions on the Power PCA, including:
    a. Initiating a capacitor charge sequence.
    b. Monitoring charge on capacitor.
    c. Initiating a shock delivery sequence.
- Control of pacing functions on the Power PCA, including:
    a. Starting/stopping pacing.
    b. Controlling Rate and Output as selected by user, and monitoring pacing current delivered.
- Control of the ECG front ends on the Parameter PCA (Leads ECG) and Power PCA (Paddles/Pads ECG).
- Generation and regulation of the 5 volt logic power supply.

Power PCA

The Power PCA performs the following functions:

- Analog front end for ECG from pads.
- Measurement of Patient Contact Impedance (PCI).
- Generation and control of pacing waveforms as directed by Control PCA.
- Control of defibrillator functions as directed by the Control PCA:
    a. Charging the capacitor to the correct energy level.
    b. Delivering the shock and controlling the waveform.
    c. Disarming (discharging) the capacitor.

Parameter PCA

The Parameter PCA performs the following functions:

- Interconnection site for ECG leads cable, ECG out cable and SpO_2 module.
- ECG analog front end for ECG from 3/5-lead cables.
- SpO2 on/off logic and patient isolation.

Keyscan PCA

The Keyscan PCA performs the following functions:

- Interconnection site for:
    a. All front panel keys.
    b. Energy Select Switch.
    c. All front panel LEDs (**Sync**, **Pacer**, **AC Power**, **Batt Charge**).
    d. IrDA interface.
    e. EL display data and control signals.
- Detecting and initial processing of front panel key presses.
- Pass through of Energy Select Switch signals.
- Interface for IrDA module (used only in manufacturing at this time).
- Pass through of EL display data and control signals.
- Internal test load for paddle discharge.

SpO_2 PCA

The SpO_2 PCA serves as the interface to the SpO_2 sensor, including:

- Generation and control of voltages to drive the LEDs in the sensor.
- Receiving and processing the signals from the SpO_2 sensor.

Battery PCA

The Battery PCA provides the contacts with which the battery mates. It also has the main fuse, and it provides the function of detecting whether the installed battery is an M3516A battery or not (see "Contacts/Battery Type" on page 6-12). It also detects the temperature of the battery.

Battery

The M3516A battery differs from similar batteries in that it is capable of providing much higher current without causing an internal protection device to open and disconnect the battery.

AC Power Module

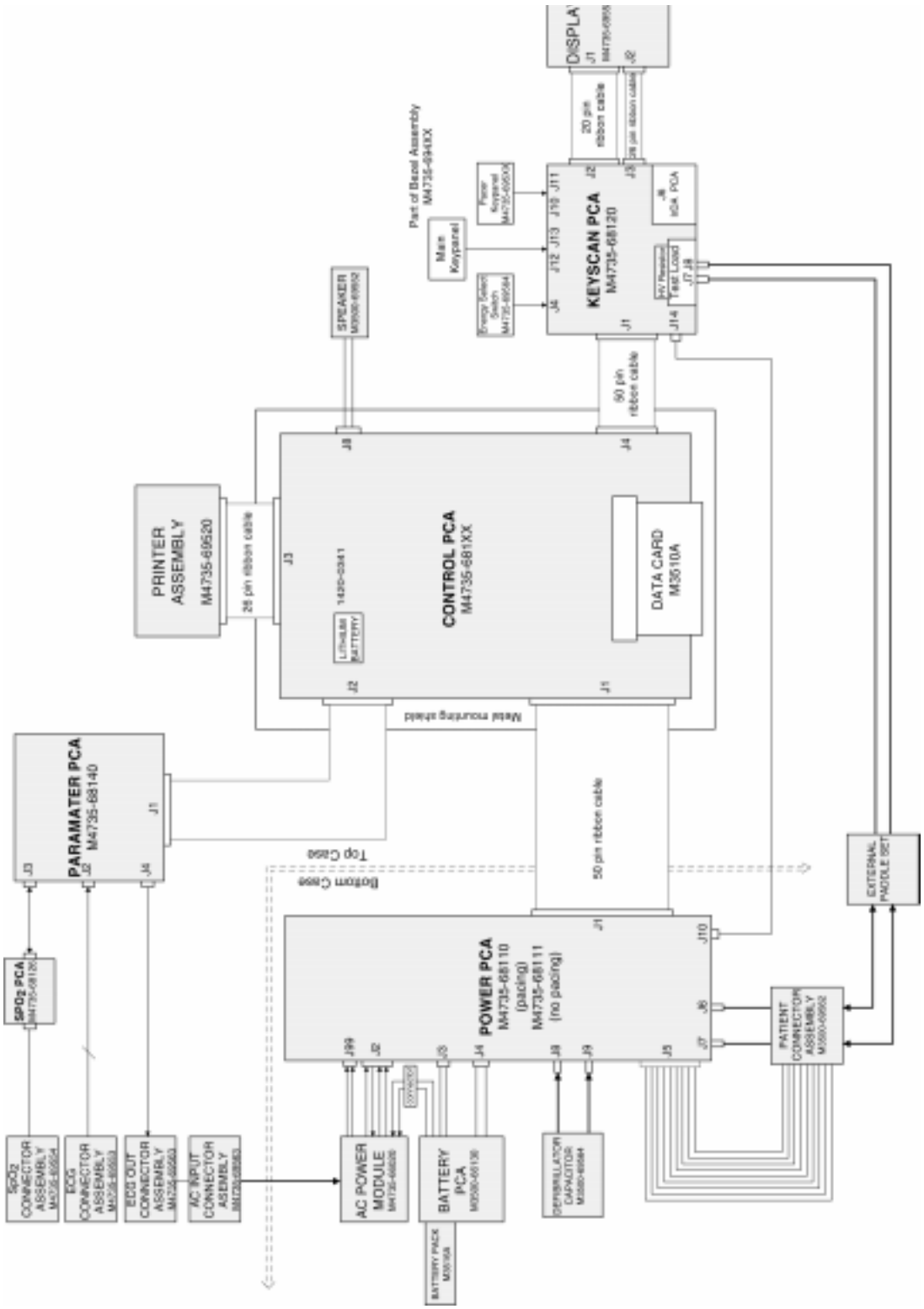
The AC Charger Module provides regulated DC power to the unit as well as charges the battery.

Printer

The printer provides hard copy output of text, waveforms, event data, etc. It senses when the paper is out, or the door is left open.

System Level Interconnections

Figure 6-1 System Interconnections



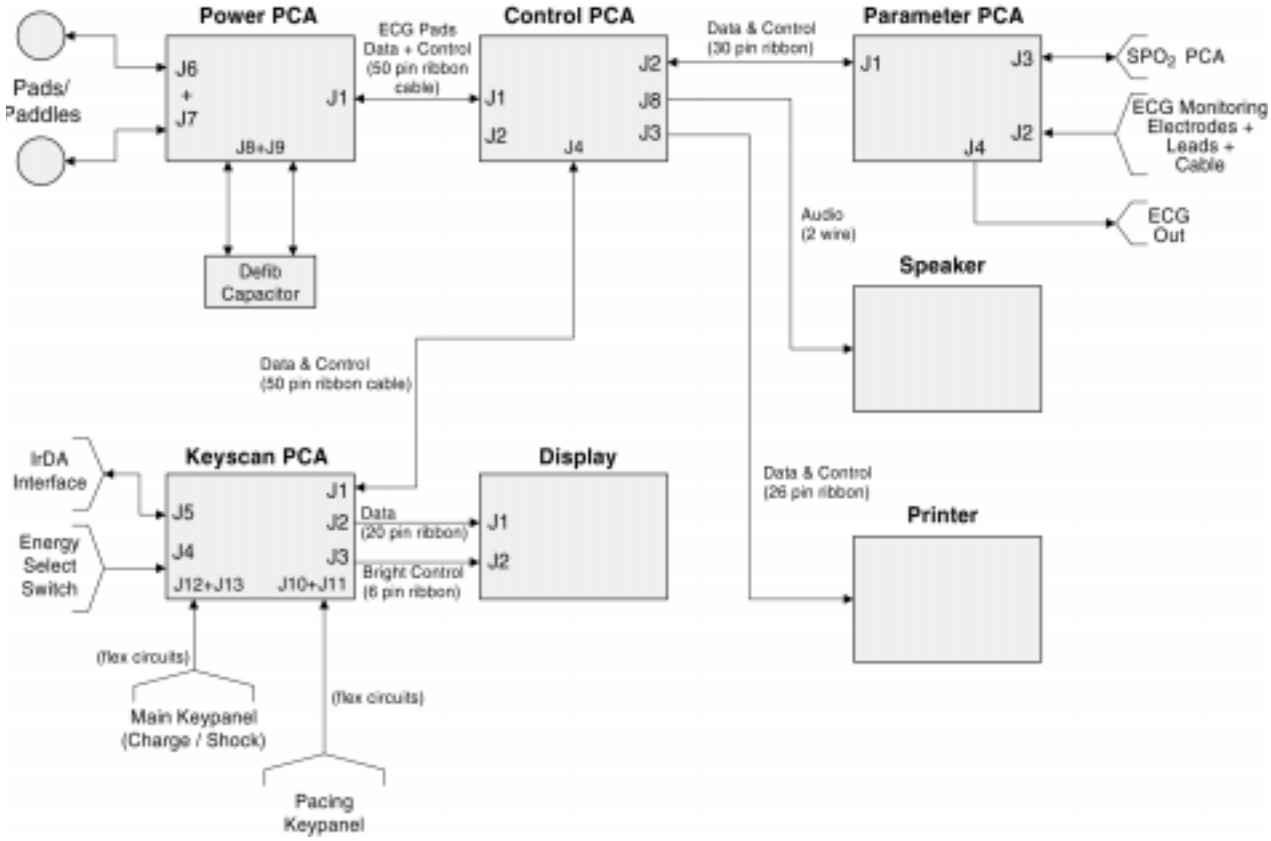
System Functional Descriptions

For all of the descriptions below, refer to Figure 6-2 "Signal and Data Flow".

Signal and Data Flow

Below is a high level block diagram representing how signals and data flow to and from the PCAs.

Figure 6-2 Signal and Data Flow



ECG Monitoring Functions

There are two separate ECG front ends - one for signals coming in on the paddles or pads cable, and one for signals coming in on the 3- or 5-lead ECG cable.

ECG - Paddles/Pads

The ECG signal picked up by the paddles or disposable defibrillation pads is carried by the cable to the pads/paddles connector, and then to the Power PCA. There it is amplified, filtered, digitized and passed across a patient isolation barrier before being passed to the Control PCA via a large ribbon cable.

The Control PCA then performs digital signal processing on the ECG data, and is responsible for:

- ECG waveform analysis and Shock Advisory (in AED Mode).
- Formatting and presenting the ECG to the display and to the printer.
- Counting heart rate and generating heart rate alarms.
- Reporting on the status of the patient connection.

ECG - 3/5-lead cable

The ECG signal picked up by the ECG monitoring electrodes is carried by the ECG cable to the ECG connector, and then to the Parameter PCA. There it is amplified, filtered, and digitized before being passed to the Control PCA via a large ribbon cable.

The Control PCA then performs digital signal processing on the ECG data, and is responsible for

- Formatting and presenting the ECG to the display and to the printer.
- Counting heart rate and generating heart rate alarms.
- Reporting on the status of the patient connection, and alerting the user to measurement problems.

Patient impedance functions

The M4735A measures patient impedance in 2 ways: an impedance measurement before the shock, and a resistance measurement during the shock.

Before the Shock

The M4735A makes a small-signal AC impedance measurement (at 32 kHz) in the steady state situation before a shock is delivered. This measurement is used to determine whether the pads are connected to the patient or not, or the paddles are making good patient contact as indicated on the LED bar graph on the Sternum paddle. The unit only displays a numeric value in Diagnostic Mode, as part of the ECG test.

During the Shock

The M4735A also makes a resistance measurement during shock delivery. This resistance is derived from measurements of voltage and current, and is reported on the printed event summary. The unit uses this value to determine whether to abort the shock, or to allow it to complete.

Since one is a small signal AC measurement of impedance and the other is a high voltage/high current measurement of resistance, it is normal and expected for them to produce slightly different numerical results.

SpO_2 Monitoring Functions

The SpO_2 signal from the sensor is carried by the external SpO_2 cable to the SpO_2 connector, and then to the SpO_2 PCA. There it is amplified, filtered, and digitized before being passed to the Parameter PCA via a flex circuit. (Power for the SpO_2 PCA and sensor is provided by the Parameter PCA via this same flex circuit.) The Parameter PCA provides on/off logic, patient isolation, and the power supply for SpO_2. It then sends the data to the Control PCA via a large ribbon cable.

The Control PCA is then responsible for:

- Formatting and presenting the O_2 saturation level, pulse rate and pleth bar to the display.
- Counting pulse rate, generating O_2 saturation level alarms.
- Reporting on the status of the sensor and its connections, and alerting the user to measurement problems.

.

Defibrillation Functions

The following sections describe the defibrillation functions.

Charging

There are 3 basic events that can initiate a charging cycle:

- In AED Mode, when the analysis algorithm determines a shock is needed and sends a signal to another section of the Control PCA.
- In Manual Mode with either pads or paddles, when front panel key #2 (**CHARGE**) is pressed, the keypress is transferred from the key to the Keyscan PCA via a flex circuit. The Keyscan PCA transfers the keypress to the Control PCA via a large ribbon cable. The keypress is then detected and processed by the Control PCA.
- Also in Manual Mode when the Apex paddle **CHARGE** key is pressed, the keypress is transferred from the key to the Power PCA via the paddles cable. The Power PCA transfers the keypress to the Control PCA via a large ribbon cable. The keypress is then detected and processed by the Control PCA

In all cases, the charging cycle is initiated and controlled by the Control PCA. It directs the Power PCA to begin charging the charge capacitor, and it monitors the voltage on the capacitor as reported back by the Power PCA.

When the Control PCA detects that the selected energy (voltage) level has been reached, it directs the Power PCA to stop charging. The Control PCA then continues to monitor the voltage on the capacitor, and as the voltage bleeds down it directs the Power PCA to top up the charge to the correct level.

Should a decision be made to change the selected energy to a lower value, the user would turn the Energy Select Switch to the desired setting. At the lower energy setting, the Control PCA directs the Power PCA to disarm (completely discharge) the capacitor then charge up to the new (lower) level.

If the requested charge is not used within 30 seconds, the Control PCA automatically directs the Power PCA to disarm the capacitor as a safety precaution.

Delivering a shock

The discharging cycle (delivering a shock) is initiated by either of two events.

- The first is by pressing the front panel key #3 (**SHOCK**) when using pads. This keypress is transferred from the key to the Keyscan PCA via a flex circuit. The Keyscan PCA transfers the keypress to the Control PCA via a large ribbon cable. The keypress is then detected and processed by the Control PCA.

- The second means of initiating a shock is by simultaneously pressing the **SHOCK** switches on both the Sternum and Apex paddles. These keypresses are transferred from the keys to the Power PCA via the paddles cable. The Power PCA transfers the keypress to the Control PCA via a large ribbon cable. The keypress is then detected and processed by the Control PCA

In either case, the Control PCA directs the Power PCA to deliver the shock. Patient resistance is derived from the current and voltage delivered during the initial portions of the waveform, and the biphasic waveform is then adjusted as needed to deliver the correct energy.

The Power PCA will abort delivery of the shock if any of the following occurs:

- During the impedance measurement, the impedance is outside of operating limits (too high or too low).
- At any time during delivery of the shock, it detects an open circuit (voltage too high for that point in the waveform) or a short circuit (current too high for that point in the waveform).

Should any of these conditions be detected, the Power PCA terminates delivery of the waveform and disarms the capacitor. The problem is reported to the Control PCA, which displays and/or prints the appropriate messages.

Another safety feature is the presence of an identification resistor in the pads and paddles cables. If the unit does not sense that resistance, it gives a **Cable Off** message and will not charge the capacitor.

Delivering synchronized cardioversion

Synchronized cardioversion operates the same as delivering a shock, except that the shock must be synchronized to the R wave of the ECG. The Control PCA is responsible for detecting the R wave and placing markers on the printed strip and on the display to indicate the timing of the proposed cardioversion shock.

A synchronized shock can be delivered in either of two ways:

- First, when using pads, by pressing and holding key #3 (**SHOCK**) until the next time an R wave is detected.
- Second, by simultaneously pressing and holding the **SHOCK** switches on both the Sternum and Apex paddles until the next time an R wave is detected.

When both events occur (either type of key press and detection of an R wave) the Control PCA directs the Power PCA to deliver the shock.

Pacing Functions

Pacing is initiated and controlled by pressing front panel keys. These key presses are transferred from the keys to the Keyscan PCA via a flex circuit. The key presses are detected and processed by the Keyscan PCA and then passed to the Control PCA via a large ribbon cable.

The Control PCA directs the Power PCA to deliver the pacing pulses at the rate and output current selected by the user. The pacing pulses are delivered via the pads cable to the defibrillation pads. The pacing current delivered is reported back to the Control PCA, which sends the info to the display and activates any printouts or screen messages as needed.

Audio Functions

The M4735A has 2 types of audio output: tones, and voice prompts. Both are generated and controlled by the Control PCA, which also amplifies the signals and passes them directly to the speaker via a dedicated connector and wire pair.

Display Functions

All display functions are handled by the Control PCA. Display formats, graphics, waveforms, numeric values, and messages are all generated and formatted by the Control PCA, using either data it has or data it receives from other parts of the unit.

Indicator Functions

All front panel LEDs (**Sync**, **Pacer**, **AC Power** and **Batt Charge**) are controlled by the Control PCA. The LEDs are connected into the Keyscan PCA via flex circuits; they are then routed to the Control PCA via a ribbon cable.

Key Functions

All keys, both on the Main Keypad and on the Pacer Keypad, connect to the Keyscan PCA via flex circuits. Keypresses from all keys are detected and processed by the Keyscan PCA and then passed to the Control PCA via a large ribbon cable. The Control PCA then interacts with the other parts of the system as needed to respond to the keypress.

Energy Select Switch

The Energy Select Switch selects operation in either AED Mode or Manual Mode.

In Manual Mode, energy selection is made by rotating the Energy Select Switch to the appropriate position. The Energy Select Switch signals pass through the Keyscan PCA and then on to the Control PCA via a large ribbon cable. The Control PCA then interacts with the other parts of the system as needed to respond to the setting of the Energy Select Switch.

Printing Functions

All printing data are handled by the Control PCA. Waveforms, graphics, numeric values, and messages are all generated and formatted by the Control PCA, using either data it has or data it receives from other parts of the unit. This data is then passed to the Printer via the printer ribbon cable.

Contrast

The printing contrast is controlled automatically by the Printer itself. The printhead senses its own temperature and impedance, and passes that information to the Control PCA. The Control PCA adjusts drive voltage to the printhead (and thus contrast) based on these readings and on battery voltage.

Out of paper/door open

The printer also incorporates an optical sensor that detects when there is no paper left, or when the printer door is open. The information is passed to the Control PCA via the printer ribbon cable; the Control PCA generates the appropriate screen message and tones to alert the user.

Battery/Power Functions

Refer to Figure 6-3 for the following descriptions.

Power for charging the battery and running the unit is supplied via the AC Power Module. The M4735A uses approximately 400-650 mA of 12 V DC when powered off to maintain configuration settings, system clock, etc. When powered on in Monitoring Mode, the unit consumes approximately 500 - 700 mA.

Instrument ground is connected to minus (-) of the AC Power Module.

Contacts/Battery Type

The battery mates with contacts on the Battery PCA. Power from the battery flows through the Main Fuse on the Battery PCA, and then through separate wires to the Power PCA for distribution to the rest of the unit.

The Battery PCA also detects whether the installed battery is an Agilent approved battery or not. It does this with a microswitch on the battery PCA,

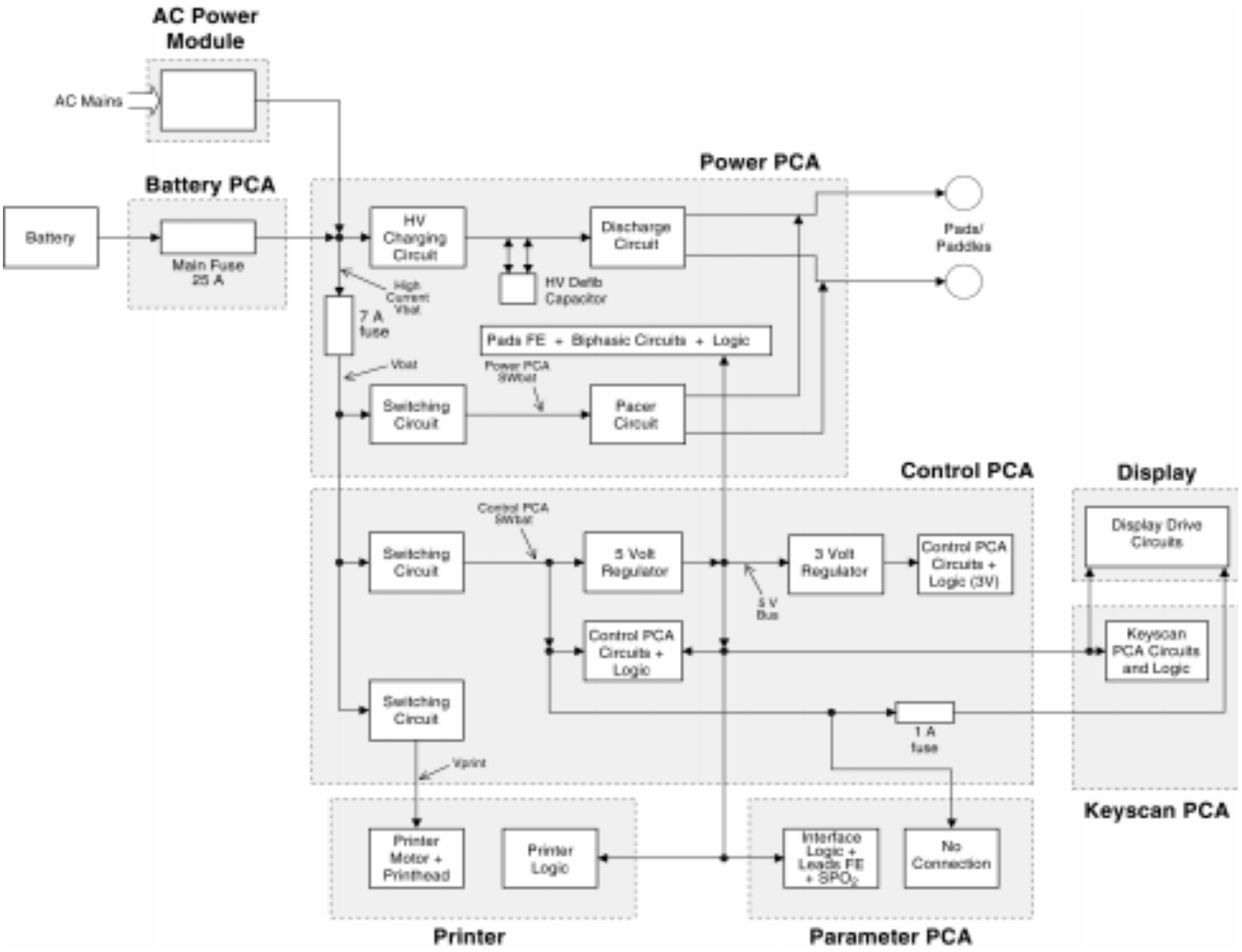
which detects if a dimpled recess is present in the end face of the battery. Agilent M3516A batteries have this dimple, while other batteries - even those that are otherwise mechanically compatible - do not.

This information is passed via a separate pair of wires to the Power PCA and from there to the Control PCA. During defibrillation, the Control PCA will direct the Power PCA to charge the defibrillator capacitor more slowly if there is a battery other than an M3516A present. This is done to reduce current drain on the battery and thus avoid tripping the thermal cutout present on many other batteries. Agilent M3516A batteries do not have this cutout; so their current delivery can be greater, allowing the defibrillator to charge more quickly.

Charging

Monitoring the battery and controlling the charging process are both handled by the AC Power Module. The Power PCA receives status information via connections both directly to the AC Power Module and to the battery. The Power PCA then sends this status information to the Control PCA via a large ribbon cable. The Control PCA processes this information and sends signals to control the **AC Power** and **Batt Charge** LED's via the Keyscan PCA. When the unit is powered on while AC is connected, the Power PCA instructs the AC Power Module to enter "power supply" mode.

Figure 6-3 Power Distribution and Fusing



Lithium Backup Battery

The Backup Battery (located on the Control PCA) provides standby power to maintain data during times when the main battery is either absent or discharged and no external power is supplied. The data maintained includes the user's configuration choices, and the system time and date.

Data Card

The Data Card allows the capture of key information such as ECG waveform, shock advisories, charging, and delivering a shock. The Data Card is read by the Code Runner Web system for post-event analysis.

CAUTION

The Data Card must only be inserted or removed when the unit's power is off. A Data Card inserted while the power is on will not be recognized by the unit. If a Card is removed while the power is on, its stored data may be corrupted and rendered unreadable.

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7 Specifications

Overview

This section provides:

- Specifications for the M4735A,
- Symbol Definitions for symbols appearing on the M4735A,
- Safety related information, and
- Electromagnetic compatibility information.

Specifications

Defibrillator

Waveform: Biphasic Truncated Exponential. Waveform parameters adjusted as a function of patient impedance.

For details of waveforms delivered, see the "Waveforms" section of this chapter.

Shock Delivery: Via multifunction defib electrode pads, or paddles.

Delivered Energy Accuracy: See Table 7-1 below..

Table 7-1 Delivered Energy vs. Load Impedance

Selected Energy (J)	Delivered Energy (J)					Accuracy
	Load Impedance (ohms)					
	25	50	100	125	150	
5	4.7	5	5.2	5.4	5.2	± 2 J
10	9.3	10	10.4	10.7	10.4	± 2 J
25	23.4	25	26.2	26.9	26.2	± 4 J
50	46.7	50	52.3	53.5	52.1	±15%
70	65.4	70	73.1	75.0	72.9	±15%
100	93.5	100	104.7	107.2	104.4	±15%
150	140.3	150	156.8	161.0	156.5	±15%
200	187	200	209.3	214.6	208.6	±15%

Charge Time: Less than 3 seconds to 200 Joules with a new, fully charged M3516A SLA battery pack at 25^{o}C. Less than 15 seconds to 200 Joules when powered by AC with no battery installed.

Patient Impedance Range: 25 to 180 Ohm.

Manual Mode

Manual Output Energy (Delivered): 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200 Joules.

Controls: Manual/AED On/Energy Select knob, Charge/Disarm, Shock, ECG Lead Select, SpO_2 On/Off, SpO_2 Alarms, HR Alarms, Sync On/Off, Pacer, Pacer Start/Stop, Pacer Rate, Pacer Current, Pacer Mode, ECG Gain, Volume, Strip, Summary, Mark.

Indicators: EL display for ECG waveform and text prompts, Audio alerts, QRS Beeper, Charging Tones (for sync and asynchronous modes), AC Power LED, Battery Charging LED, Sync LED, Pacer LED.

Armed Indicators: Charge done tone and available energy indicated on display.

Energy Selection: Front panel rotary knob.

Charge Control: Front Panel "2" key or buttons on paddles.

Shock Control: Front Panel "3" key or buttons on paddles.

Synchronizer: SYNC message appears on the monitor and is annotated on the printer (if printing while in Sync Mode). An audible beep sounds with each detected R-wave, while a tick mark on the monitor and printed strip indicate the discharge points. Synchronizer delay is less than 60 msec from peak R-wave to peak current of the defibrillation discharge.

AED Mode

AED Energy Profile: Fixed Energy (150 Joules).

AED Shock Series: 2, 3, or 4 shocks per series.

Shock Series Timer: off, 30, 60, 90, 120, 150, 180, or 210 seconds.

Text and Voice Prompts: Extensive text and audible messages guide user through protocol.

AED Controls: On, Off, Pause/Resume, Analyze/Stop Analysis, Shock, Lead Select, SpO_2 On/Off, SpO_2 Alarms, HR Alarms, ECG Gain, Volume, Strip, Summary, Mark.

Indicators: EL display for ECG waveform and text prompts, Audio alerts, Voice prompts, QRS Beeper, Charging Tone, Charge Done Tone, printer, AC Power LED, Battery Charging LED.

Armed Indicators: Charge Done Tone, Available Energy indicated on display, Voice Message.

Patient Analysis: Per protocol, evaluates patient ECG and signal quality to determine if a shock is appropriate and evaluates connection impedance for proper defibrillation pad contact.

Shockable Rhythms: Ventricular fibrillation with amplitude > 100 uV and wide complex ventricular tachycardia with rates greater than 150 bpm.

Sensitivity and Specificity: Meets AAMI guidelines.

ECG Monitoring

Inputs: Single channel ECG may be viewed on display and printed. Pads ECG is obtained through two multifunction defibrillation electrode pads. Lead I, II, or III is obtained through the 3-lead ECG cable and separate monitoring electrodes. With a 5-lead cable, lead aVR, aVL, aVF, or V can also be obtained.

Lead Fault: LEADS OFF message and dashed line appear on the display if an electrode or lead wire becomes disconnected.

Paddle Fault: NO PADDLES CONNECTED message and dashed line appear on the display if paddles become disconnected.

Pad Fault: PADS OFF message and dashed line appear on the display if a pad becomes disconnected.

Heart Rate Display: Digital readout on display from 15 to 300 bpm, with an accuracy of ±10%.

Heart Rate Alarms: Configurable pairs of low and high heart rate alarm limits: 30 to 100, 60 to 140, 90 to 160, and 120 to 200 bpm.

Hands Free Defibrillation Patient Cable Length: 7 ft. (2.13 m).

ECG Cable Length: 12 ft. (3.7 m).

Common Mode Rejection: Greater than 90 dB measured per AAMI standard for cardiac monitors (EC 13).

ECG Size: 2.5, 5, 10, 20, 40 mm/mV.

Frequency Response:

AC Line Filter: 60 Hz/50Hz.

Pads ECG for Display: Monitor (.15-40 Hz) or EMS (1-30 Hz).

Pads ECG for Printer: Monitor (.15-40 Hz) or EMS 1-30 Hz).

Leads ECG for Display: Monitor (.15-40 Hz) or EMS (1-30 Hz).

Leads ECG for Printer: Diagnostic (.05-150 Hz) or EMS (1-30 Hz) or Monitor (.15-40 Hz).

Patient Isolation (defibrillation proof):

ECG: Type CF

SpO_2: Type CF

Defib: Type BF

Display

Size: 115 mm x 86 mm.

Type: EL - Electroluminescent.

Resolution: 320 x 240 pixels.

Sweep Speed: 29 mm/s nominal (stationary trace; sweeping erase bar).

Viewing Time: 4 seconds.

Battery

Type: 2 Ah, 12V, rechargeable, Sealed Lead Acid.

Dimensions: 2.4" (H) x 0.94" (W) x 7.2" (D).
61.7 mm (H) x 23.9 mm (W) x 182 mm (D).

Weight: 1.4 lb. (0.65 kg).

Charge Time:

- Approximately 14.5 hours to 100%.
- Approximately 3 hours to 90%, indicated by LED on front panel.

Capacity: With a new, fully charged battery at room temperature (25^oC):

- 100 minutes ECG monitoring or
- 50 full-energy discharges or
- 75 minutes ECG monitoring while pacing.

Battery Indicators: LOW BATTERY message appears on display when at least 10 minutes of monitoring time and 5 maximum-energy discharges remain (with a new battery at room temperature - 25^oC).

Battery Storage: Should not be stored above 40^{o}C for extended periods of time.

Charger Output: Unit can be operated using only AC power, with no battery installed.

Thermal Array Printer

Continuous Real Time Strip:

User starts and stops the strip. The Print Strip prints the selected ECG lead with the following data:

HEADER 1: Date, Time, Heart Rate, the SpO_2 Value (if available), and the text "Delayed" if printing has been configured for Delayed Mode. Prints every 12 seconds.

HEADER 2: Current mode (AED/Manual), Lead, Gain, filter setting, the text "Sync" (if Sync has been enabled), and Pacer Settings (consisting of the Pacer Mode, Rate, and Current, if currently pacing the patient). Prints every 12 seconds, with Header 1.

HEADER 3: Changes in Mode, Gain, Lead, Sync, and Pacer Settings.

FOOTER: Drug Annotations, HR/SpO_2 limits on a Limit Alarm, the Results of Analysis in AED Mode (No Shock Advised, Shock Advised, or Cannot Analyze), Charging to xxxJ, Shock Delivered, No Shock Delivered, Disarm, Battery Low.

SYMBOLS: Mark Triangle (for presses of the Mark key), an Alarm Bell (Alarm Limit Violations), Lightning Bolt (Shock Delivered; followed by b for biphasic), Vertical stripe Boundaries/Pacer/Sync Tick Marks.

Event Printing: Mark key automatically documents ECG and events during defibrillation episodes. The Mark key can annotate the event with one of the following labels: Epinephrine (Adrenaline), Atropine, Lidocaine, and Other.

Auto Printing: The printer can be configured to automatically print on Mark, Charge, Shock and Alarm.

Delayed Printing: The printer can be configured to run real time or with a six second delay.

Reports: The following can be printed: Event Summary, Configuration, Extended Self Test, System Log, Battery Capacity Test, Shift/System Check.

Speed: 25 mm/s with an accuracy of ±5%.

Amplitude Accuracy: ±10% or ±50 uV, whichever is greater.

Paper Size: 50 mm by 30 m (100 ft.).

Noninvasive Pacing

Waveform: Monophasic Truncated Exponential.

Current Pulse Amplitude: 10 mA to 200 mA (5 mA resolution); accuracy 10 mA - 50 mA ±5 mA, 50 mA - 200 mA ±10%.

Pulse Width: 20 ms with accuracy +0, -5 ms.

Rate: 30 ppm to 180 ppm (10 ppm increments); accuracy ±1.5%.

Modes: Demand or Fixed Rate.

Refractory Period: < 80 ppm: 340 msec ±10%
> 80 ppm: 240 msec ±10%

SpO_2/Pulse Oximetry

Accuracy with:

M1191A sensor - 1 standard deviation 70% to 100%, ±2.5%.

M1192A sensor - 1 standard deviation 70% to 100%, ±2.5%.

M1194A sensor - 1 standard deviation 70% to 100%, ±4.0%.

NELLCOR sensors - 1 standard deviation 80% to 100% ±3.0%.

Resolution: 1%.

SpO_2 Alarm Limits: Three preset low alarm limits: 90%, 85%, and 80%.

INOP Alerts: Triggered by disconnected sensor, noisy signal, light interference or low signal (non-pulsatile).

Event Storage

Internal Event Summary:

The internal Event Summary stores up to 300 events and up to 50 waveforms.

Events can be marked with a Mark symbol and, if configured for drug annotation, the following labels can be added: Epinephrine (Adrenaline in U.K. and Australia), Atropine, Lidocaine, or Other.

The Summary key on the front panel is used to print the internal Event Summary.

Data Card Event Summary:

The Data Card stores continuous ECG waveforms and events on a Type II PCMCIA card, SanDisk SDP3B 8MB ATA FlashDisk. One 8MB card can store approximately 2 hours of continuous ECG waveforms and events.

General

Dimensions: 19.0 cm (H) x 37.6 cm (W) x 34.6 cm (L)

7.5" x 14.8" x 13.7"

Weight: Standard Configuration weighs 6.5 kg (14.3 lbs.) including battery, full roll of paper, and external paddles.

Environmental

Temperature: 0^{o} to 50^{o}C operating, -20^{o} to 70^{o}C storage.

- Thermal paper may darken above 55^{o}C.
- Charging the battery at temperatures above 35^{o}C may degrade battery life.
- Storing the battery for extended periods at temperatures above 40^{o}C will reduce battery capacity and degrade battery life.

Humidity:

Up to 95% Relative Humidity

- Printer may jam if paper is wet.
- Printer may be damaged if wet paper is allowed to dry while in contact with the printhead elements.

Altitude:

- Operating: up to 15,000 ft.
- Storage: up to 15,000 ft.

Shock: Agilent Technologies Corp. Section 760, End Use Class B1, Transportation Type 1.

Vibration: Agilent Technologies Corp. Section 759 Class B1 Vibration.

Water Resistance: Meets IEC 601-2-4.

Safety: Meets IEC 60601-1

EMC: Meets EN 60601-1-2.

Other Considerations: Equipment not suitable for use in the presence of a flammable anesthetic mixture with air, oxygen, or nitrous oxide.

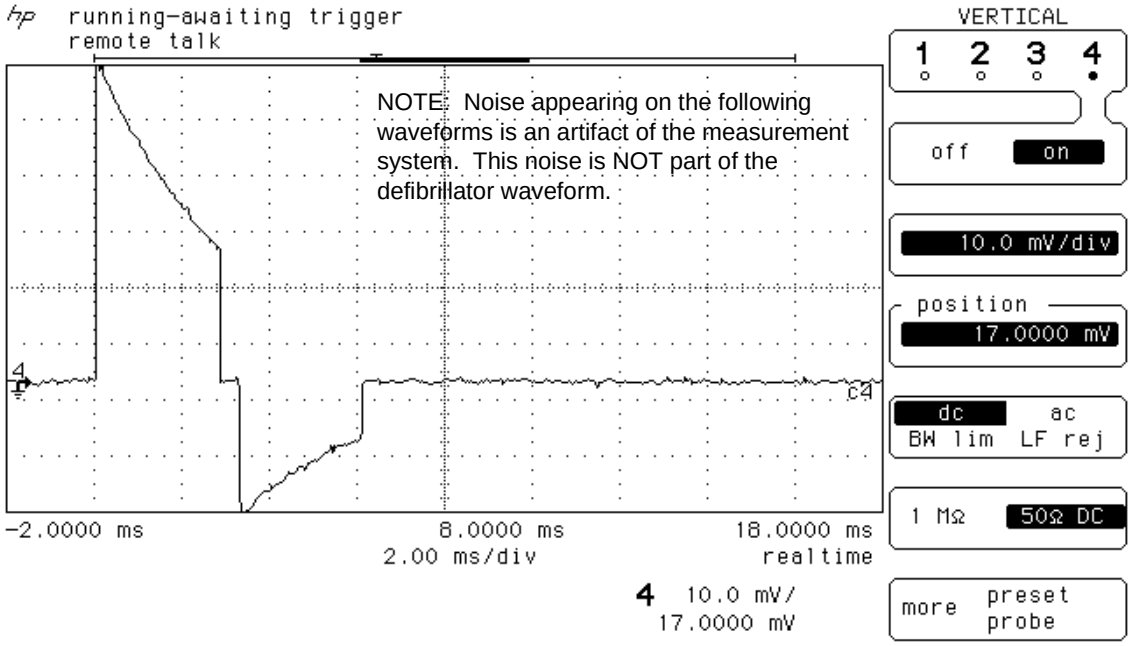
Mode of Operation: Continuous.

AC Line Powered: 100-240 VAC, 50/60 Hz, .3A (Class 1).

Battery Powered: 12 V Rechargeable, SLA.

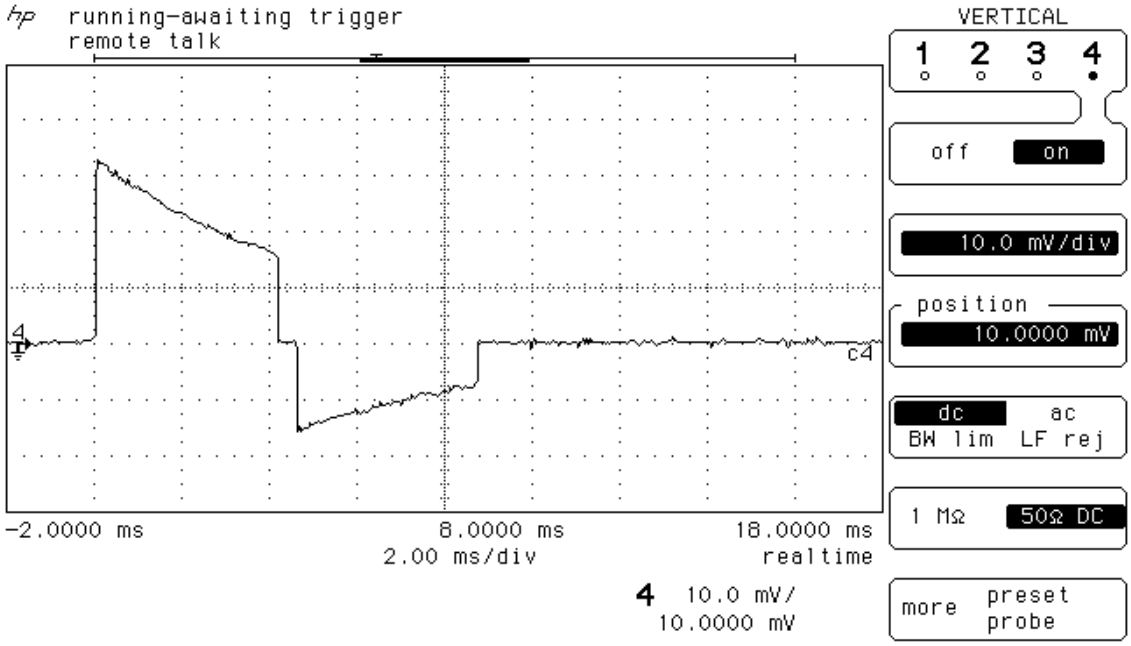
Waveforms - 150J

150J, 25 ohms



This image displays the defibrillator current waveform for a 150J discharge into 25ohms. The current probe is set to 10A/division (10A/10mV). The peak current is about 58A.

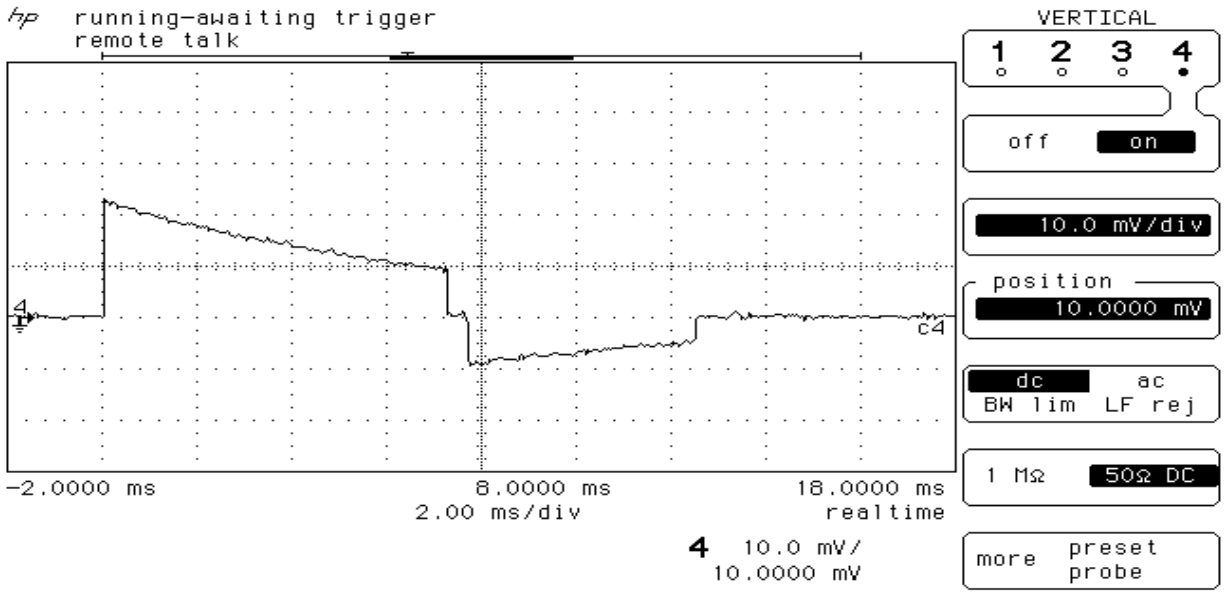
150J, 50 ohms



This image displays the defibrillator current waveform for a 150J discharge into 50ohms. The current probe is set to 10A/division (10A/10mV). The peak current is about 33A.

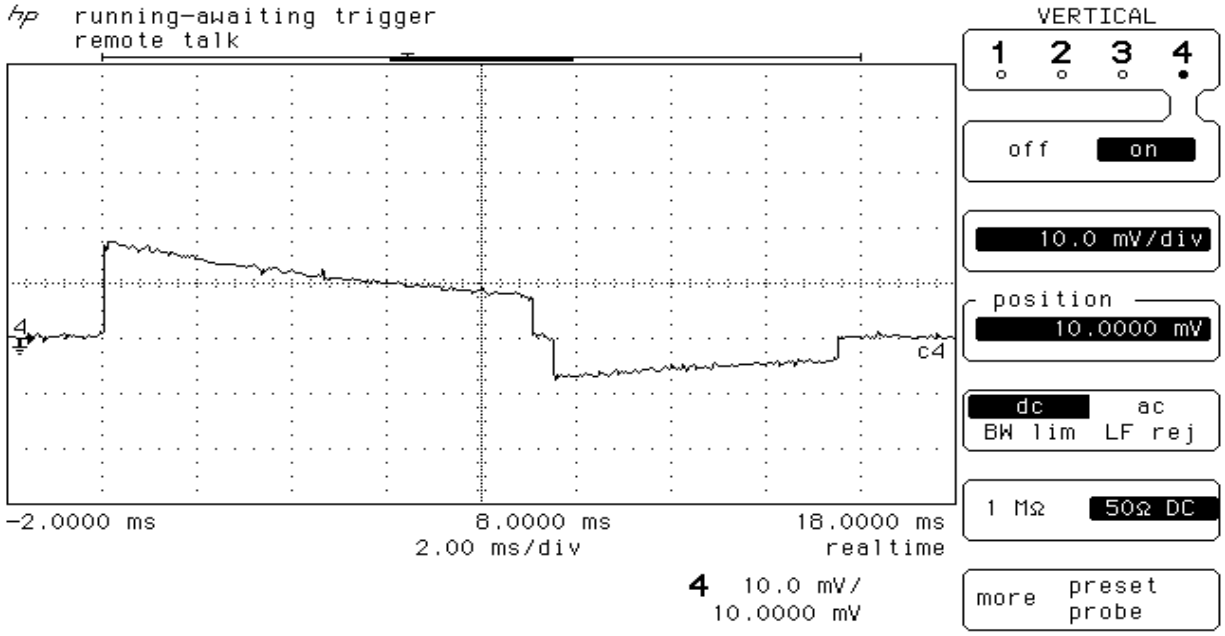
Waveforms -150J (continued)

150J, 75 ohms



This image displays the defibrillator current waveform for a 150J discharge into 75ohms. The current probe is set to 10A/division (10A/10mV). The peak current is about 23A.

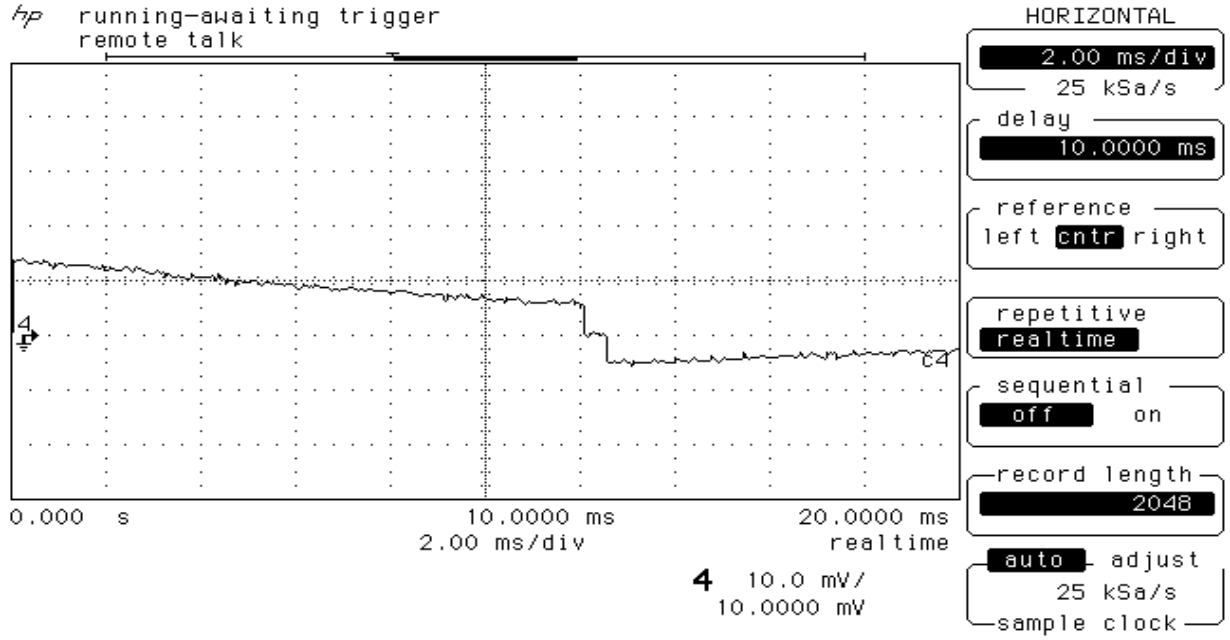
150J, 100 ohms



This image displays the defibrillator current waveform for a 150J discharge into 100ohms. The current probe is set to 10A/division (10A/10mV). The peak current is about 17A.

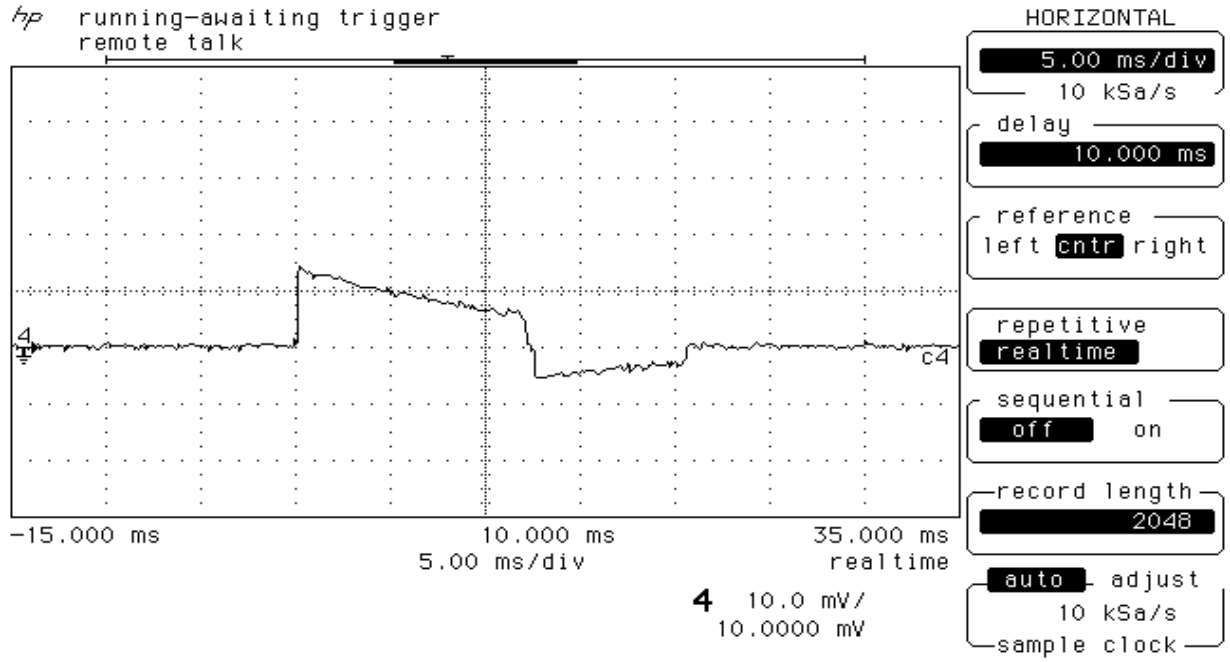
Waveforms -150J (continued)

150J, 125 ohms (2ms/div)



This image displays the defibrillator current waveform for a 150J discharge into 125ohms. The current probe is set to 10A/division (10A/10mV). The peak current is about 14A. Note that the trailing edge of the waveform is just off the right edse of the screen.

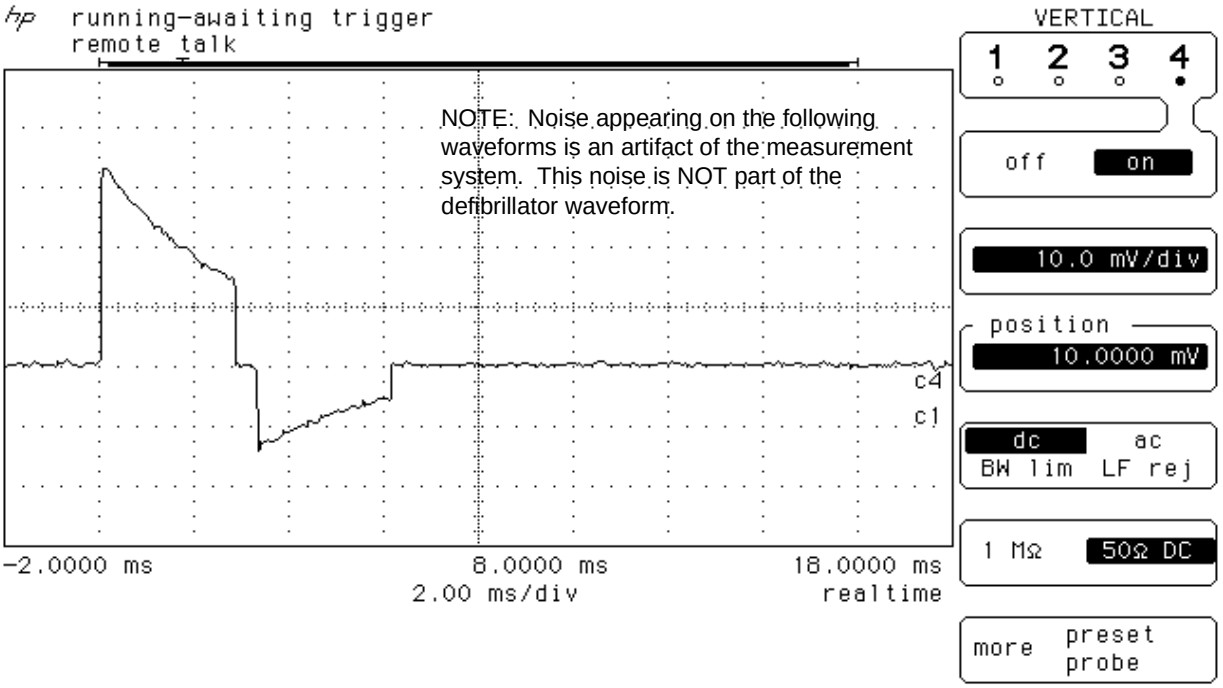
150J, 125 ohms (5 ms/div)



This image displays the defibrillator current waveform for a 150J discharge into 125ohms. The current probe is set to 10A/10mV (10A/10mV). The peak current is about 14A. Note that the timebase has been changed to 5ms/division so that the entire waveform could be captured.

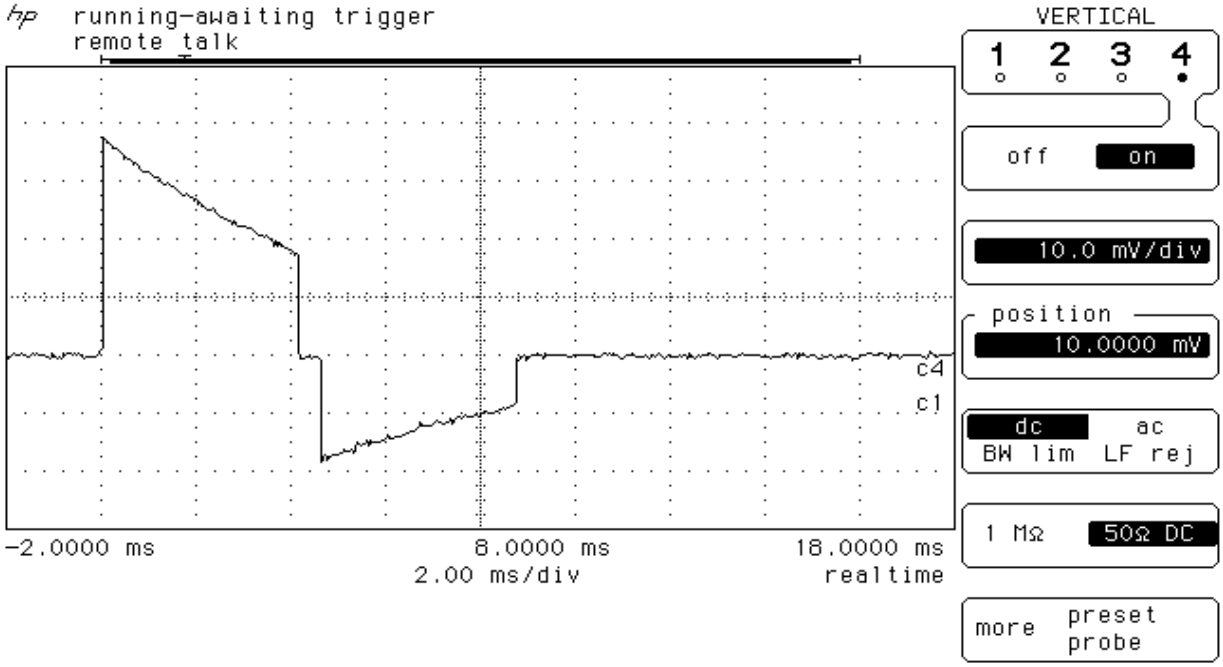
Waveforms - 200J

200J, 25ohms



This image displays the defibrillator current waveform for a 200J discharge into 25ohms. The current probe is set to 20A/div (20A/10mV). The peak current is about 66A.

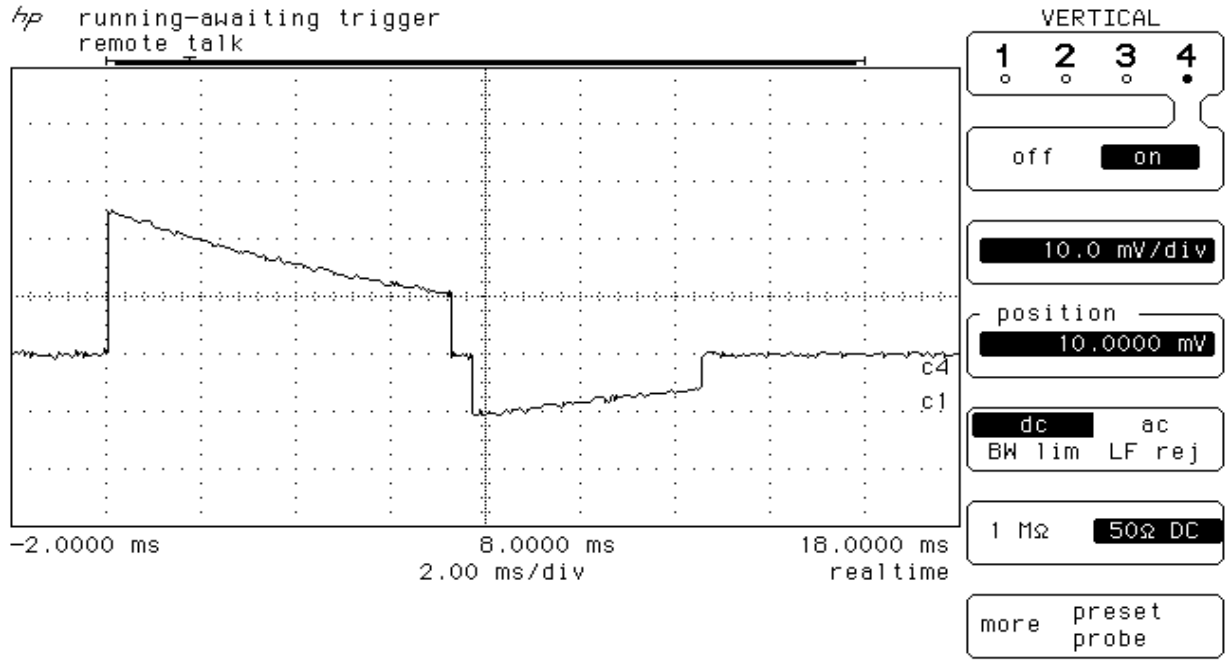
200J, 50ohms



This image displays the defibrillator current waveform for a 200J discharge into 50ohms. The current probe is set to 10A/div (10A/10mV). The peak current is about 37A.

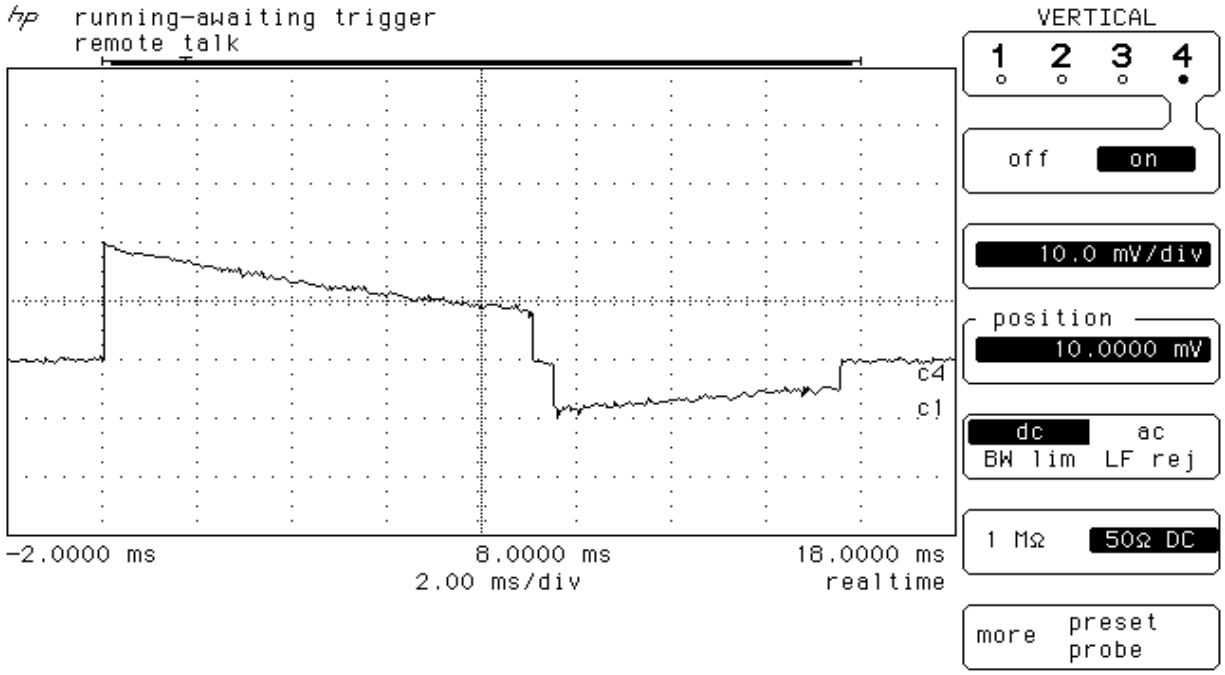
Waveforms - 200J (continued)

200J, 75ohms



This image displays the defibrillator current waveform for a 200J discharge into 75ohms. The current probe is set to 10A/div (10A/10mV). The peak current is about 25A.

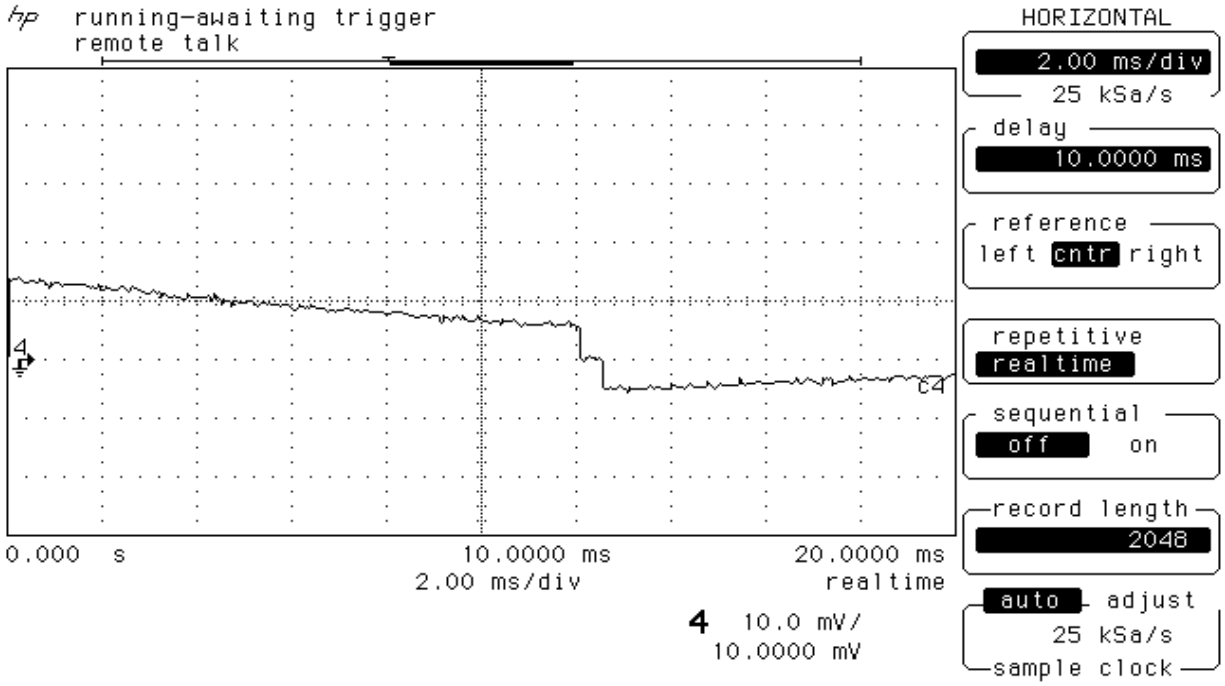
200J, 100ohms



This image displays the defibrillator current waveform for a 200J discharge into 100ohms. The current probe is set to 10A/div (10A/10mV). The peak current is about 20A.

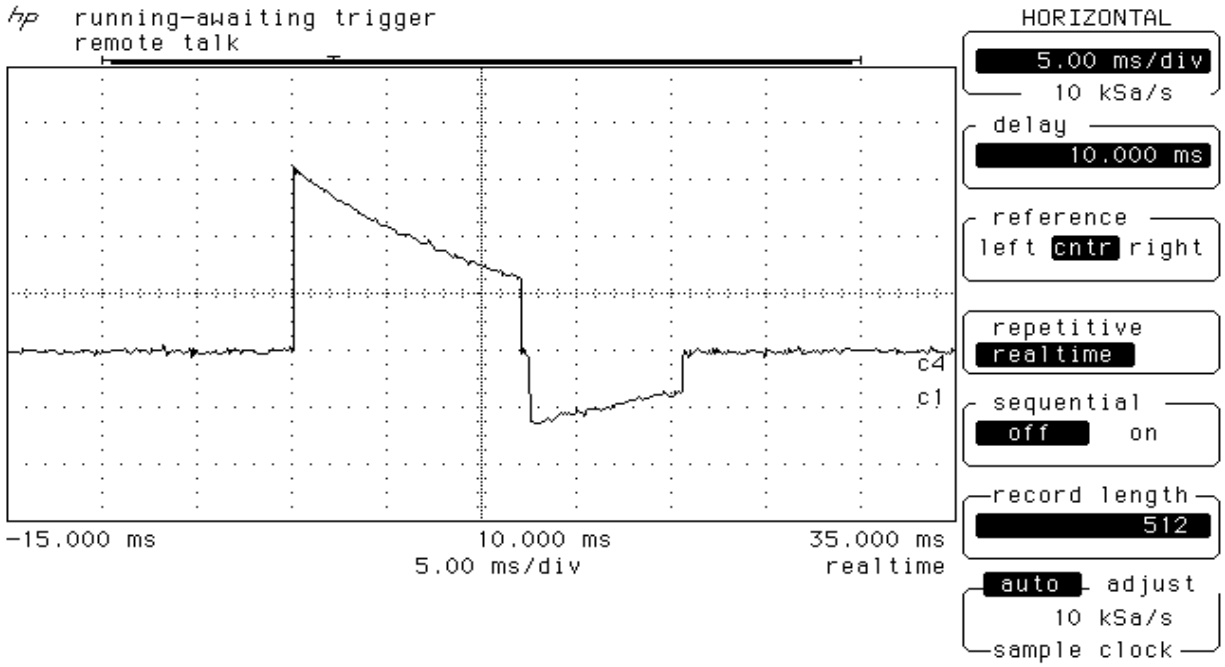
Waveforms - 200J (continued)

200J, 125ohms (2ms/div)



This image displays the defibrillator current waveform for a 150J discharge into 125ohms. The current probe is set to 10A/division (10A/10mV). The peak current is about 14A. Note that the trailing edge of the waveform is just off the right edse of the screen.

200J, 125ohms (5ms/div)



This image displays the defibrillator current waveform for a 200J discharge into 125ohms. The current probe is set to 5A/div (5A/10mV). The peak current is about 16A. The timebase for this image is 5ms/div.

7

Symbol Definitions

The following table lists the meanings of each symbols shown on the M4735A and the M3516A battery:

Table 7-2 Defibrillator and Battery Symbols

Symbol	Definition
	Shock hazard.
	Caution - See operating instructions in ***User's Guide***.
	Input
	Meets IEC type BF leakage current requirements and is defibrillator protected (Patient Applied Part is isolated and defib-proof suitable for direct patient contact except the heart or major arteries.)
	Meets IEC type CF leakage current requirements and is defibrillator protected (Patient Applied Part is isolated and defib-proof suitable for direct patient contact including the heart and major arteries).
	Alarms are active.
	Alarms are inactive.
	Recyclable material.
	Must be recycled or disposed of properly.
	Unlock.
	Audio speaker.
	Protective earth ground.
	Alternating current
	Dangerous Voltage

The following table lists the symbols that appear on the M4735A shipping carton:

Table 7-3 Shipping Carton Symbols

Symbol	Definition
	Atmospheric pressure range.
	Temperature range.
	Relative humidity range.
	Recyclable paper product.
	Fragile.
	Right side up.
	Do not get wet.
	Shelf life.
	Long-term storage conditions.
	Short-term transport storage.

Safety Considerations

The following general warnings and cautions apply to use of the Heartstream XL. Additional warning and cautions specific to a particular feature are provided in the appropriate section.

WARNING

The Heartstream XL is not intended to be deployed in settings or situations that promote use by untrained personnel. Operation by untrained personnel can result in injury or death.

WARNING

Remain attentive to the patient during the delivery of therapy. Delay in delivering a shock may result in a rhythm that was analyzed as shockable converting spontaneously to non-shockable and could result in inappropriate delivery of a shock.

WARNING

Use only the multifunction defib electrode pads, battery, and accessories listed in Table 5-16 on page 3-18. Substitutions may cause the Heartstream XL to function improperly.

WARNING

Use multifunction defib electrode pads prior to their expiration date. Discard pads after use. Do not reuse pads. Do not use for more than 8 hours of continuous pacing.

WARNING

In AED Mode, the multifunction defib electrode pads must be in the anterior-apex position as shown on the packaging. The Heartstream XL was not designed to assess data acquired from pads in an anterior-posterior position.

WARNING

Use only 3-wire AC power cords with 3-pronged grounded plugs.

WARNING

Keep hands and feet clear of paddle electrode edges. Use your thumbs to depress the shock buttons on the paddle handle.

CAUTION

Conductive parts of electrodes and associated connectors for applied parts, including the neutral electrode, should not contact other conductive parts including earth.

WARNING

Do not allow multifunction defib electrode pads to touch each other or to touch other ECG monitoring electrodes, lead wires, dressings, etc. Contact with metal objects may cause electrical arcing and patient skin burns during defibrillation and may divert current away from the heart.

WARNING	**During defibrillation, air pockets between the skin and multifunction defib electrode pads may cause patient skin burns. To help prevent air pockets, make sure the pads completely adhere to the skin. Do not use dried out pads; do not open pads package until just prior to use.**
WARNING	**Never touch the patient or any equipment connected to the patient (including the bed or gurney) during defibrillation.**
WARNING	**Never operate the Heartstream XL in standing water.**
WARNING	**Do not immerse, or pour fluids on, any portion of the Heartstream XL.**
WARNING	**Do not use the Heartstream XL in a flammable or oxygen-rich atmosphere. This can cause an explosion hazard.**
WARNING	**Avoid connecting the patient to several devices at once. Leakage current limits may be exceeded. Do not use a second defibrillator on the patient while pacing with the Heartstream XL.**
NOTE	The Heartstream XL can be operated with only AC line power, only 12v M3516A SLA Battery or AC power and M3516A SLA battery simultaneously.
WARNING	**Avoid contact between the patient and conductive fluids and/or metal objects, such as the gurney. Contact with metal objects could cause unintentional current pathways.**
WARNING	**Operating the Heartstream XL or its accessories in conditions outside the environmental specifications can result in device or accessory malfunction.**
WARNING	**Medical electrical equipment which does not incorporate defibrillator protection should be disconnected during defibrillation.**
WARNING	**Electric shock hazards exist internally. Do not remove assembly screws. Refer servicing to qualified personnel.**

CAUTION	This device has not been evaluated for use with electrosurgery equipment.
NOTE	This device and accessories are not intended for home use.
CAUTION	Do not discharge the defibrillator with the paddles shorted together.
WARNING	**Properly dispose of or recycle depleted batteries according to local regulations. Do not puncture, disassemble, or incinerate batteries.**
WARNING	**Where the integrity of the external protective earth conductor is in doubt, the device shall be operated from its internal power source.**
NOTE	For operation in the U.S., the attachment plug must be the proper NEMA type for connection to the alternative voltage.
CAUTION	Be aware of patient cables, including ECG monitoring equipment when used with high frequency surgical equipment.

Electromagnetic Compatibility

When using the M4735A Heartstream XL Defibrillator/Monitor, electromagnetic compatibility with surrounding devices should be assessed.

A medical device can either generate or receive electromagnetic interference. Testing for electromagnetic compatibility EMC with and without the appropriate accessories has been performed according to the international standard for EMC for medical devices (IEC 60601-1-2). This IEC standard has been adopted in Europe as the European Norm (EN 60601-1-2).

The EMC standards describe tests for both emitted and received interference. Emission tests deal with interference generated by the device being tested.

WARNING

Radio frequency (RF) interference from nearby transmitting devices may degrade performance of the M4735A Heartstream XL Defibrillator/Monitor. Electromagnetic compatibility with surrounding devices should be assessed prior to using the defibrillator.

Reducing Electromagnetic Interference

The M4735A Heartstream XL Defibrillator/Monitor and associated accessories are susceptible to interference from other RF energy sources and continuous, repetitive, power line bursts. Examples of other sources of RF interference are medical devices, cellular products, information technology equipment and radio/television transmission. Should interference be encountered, as demonstrated by artifact on the ECG or dramatic variations in SpO2 values, attempt to locate the source. Assess:

- Is the interference intermittent or constant?
- Does the interference occur only in certain locations?
- Does the interference occur only when in close proximity to certain medical devices?
- Does the SpO2 value change dramatically when the AC line cord is unplugged?

Once the source is located, attempt to attenuate the EMC coupling path by distancing the defibrillator from the source as much as possible. If assistance is needed, call your local service representative.

Restrictions for Use

Artifact on the ECG caused by electromagnetic interference should be evaluated by a physician or physician authorized personnel to determine if it will negatively impact patient diagnosis or treatment.

Immunity Level

The EMC standards state that manufacturers of patient-coupled equipment must specify immunity levels for their systems. It is recognized that the M4735A defibrillator/monitor is designed to receive and amplify low level signals in the same bandwidth as the interference.

Immunity is defined in the standard as the ability of a system to perform without degradation in the presence of an electromagnetic disturbance. Degradation in ECG quality is a qualitative assessment which can be subjective.

Caution should, therefore, be taken in comparing immunity levels of different devices. The criteria used for degradation is not specified by the standard and may vary with the manufacturer.

NOTE

For additional information about compliance with the EMC standards, please see the Declaration of Conformity Statement available at:

http://www.healthcare.agilent.com/mpg-reginfo/conformity.html

Index

A

AC Power Module
See Power Module
Accessories 5-1, 5-18
ordering 7-16
AED Mode 1-1, 3-21, 7-3
Amplifier test 2-30
Attach Pads 3-14
Audio tone 6-11
operational problems 3-27
speaker removal and replacement 4-64
testing 2-26
troubleshooting 3-16

B

Battery 6-4, 6-12
Battery Capacity Test 2-40
Battery Charger Adapter 1-3, 5-20
Battery Eject Assembly 5-12
charging 1-2, 3-21
cover replacement 4-10
disposal 4-3
Lithium Backup Battery 4-34, 5-7, 5-9, 6-15
Low Battery 3-12
operational problems 3-29
PCA 4-80, 5-8, 5-21, 6-4
repair philosophy 1-3
specifications 7-4
testing 2-6, 2-36
Bottom case assembly 5-12
Branding label set 5-17

C

Cable
pads cables 5-19, 5-24
placement 4-2
printer 4-62
SpO2 adapter 5-19
tie wrap 5-13
Capacitor
defibrillator 4-30, 4-84, 5-8, 5-22
power supply 4-24
Carrying case
bottom case assembly 5-12
closing 4-99
discharging capacitors 4-24, 4-30
separating 4-26
top case assembly 4-75, 4-97, 5-12
Case label set 4-20, 4-77, 4-98
Check Printer 3-14
CODEC test 2-23
Configuration Lost 3-12
Configuration Mode 2-10, 3-4, 3-5
Connector 5-12, 5-23
ECG 4-60
Patient 4-94
retainer clip 5-13
Control PCA 6-2
replacement 4-36, 5-7, 5-21
Software Support Tool 2-12

D

Data Card 3-4, 6-15
- Data Card Disabled 3-12
- Data Card Full 3-14
- Data Card Interrupted 3-15
- Data Card Not In Service 3-15
- door replacement 5-12
- Event Summary 7-6
- Incompatible Data Card 3-15
- No Data Card Present 3-15
- operational problems 3-30
- replacement 5-19
- test 2-23

Defibrillator 1-1
- AC power test 2-6, 2-35
- battery test 2-6, 2-36
- capacitor 4-30, 4-84, 5-8, 5-22
- charging 1-2, 3-21, 6-9
- Defib Disarmed 3-14
- Defib Failure 3-13, 3-24
- dimensions and weight 7-7
- Disarm Test 2-6, 2-38
- discharging 4-30
- disposal 4-3
- Extended Self Test 2-24
- operational problems 3-21
- pads 5-19
- specifications 7-1
- test load 5-20

Diagnostic test
- Defibrillator Disarm Test 2-38
- Defibrillator Test (AC Power) 2-35
- Defibrillator Test (Battery Power) 2-36
- Diagnostic Mode 2-11
- ECG test 3-20
- Extended Self Test 2-4, 2-22, 3-17
- Pacing test 2-5, 2-24, 2-33
- System Log 2-20
- User Interface Tests 2-4, 2-25

Disarm Pathway 4-30

Display
- operational problems 3-26
- removing and replacing 4-54, 5-8, 5-22
- specifications 7-4
- testing 2-26

E

Earth leakage 2-39

ECG monitor
- amplifier tests 2-30
- connector 4-60, 5-12
- ECG Fault 3-12
- frequency response 7-4
- functional checks 2-16
- operational problems 3-18
- PCI function 2-32
- specifications 7-3
- status messages 2-30
- tests 2-5, 3-20

Electrode, monitoring 5-19

Electromagnetic compatibility (EMC) 7-19

Environmental specifications 7-7
- safety precautions 7-17

Error code 3-4, 3-5, 3-10

Event Summary 7-6

Extended Self Test 2-4, 2-22
- failures 3-17

External assembly
battery cover 4-10
Battery Eject Assembly 5-12
Data Card door 5-12
main fuse 4-12, 5-9

F

Flex circuit connection 4-2
Front End (FE) test 2-24
Leads/Pads 2-30
Functional Check 2-4
ECG 2-16
Shock Advisory 2-17
SpO2 2-18
Synchronized Cardioversion 2-18

H

Heart Rate (HR) function 2-16
Heartstream XLT
safety precautions 7-17

I

Immunity level 7-20
Incompatible Data Card 3-15
Indicator functions 6-11, 7-2, 7-3
Installation 1-2
Internal subassembly 4-32
IRDA test 2-23

K

Key
See Softkey
Key Component 4-1, 5-21
Key Inactive 3-15
Keypad
See Manual Keypad

L

Label
branding label set 5-17
case label set 4-20, 4-77
Primary 4-98
speaker assembly 5-17
LCD Display
See Display
Leads FE test 2-30
Leads Off 3-12, 3-18, 3-19
LED 7-2
Lithium Backup Battery 4-34, 5-7, 5-9, 6-15
Load impedance 7-2
Low Battery 3-12

M

M3500B Unit Exchange Program 5-5
Main fuse 4-12, 5-9
Maintenance 1-2
Mandatory testing
External Repairs/No Trouble Found 2-2
Internal Repairs 2-3
printer 2-3
Manual Keypad
removing and replacing 5-11, 5-22
testing 2-25
Manual Mode 1-1, 3-21, 7-2
Momentary message 3-14
Monitor Failure 3-12
Monitoring electrode 5-19
ms to Charge 2-37

N

No Data Card Present 3-15
No Pads 3-12
No Shock Delivered 3-14, 3-24
Non Pulsatile 3-13

O

Operational 3-18
Operational Problems table 3-4

P

Pacing 6-11
operational problems 3-24
Pacer Failure 3-13
Pacer Hardware Not Installed 3-24
Pacer Output Low 3-13
specifications 7-6
Stop Pacer 3-15
testing 2-5, 2-24, 2-33
Pads
applying 7-16
Attach Pads 3-14
defibrillation 5-19
No Pads 3-12
Pads Cable Off 3-12
Pads FE test 2-30
Pads Off 3-13, 3-19
safety precautions 7-16
Paper 5-18
Patient Connector 4-94, 5-12, 5-23
Patient lead leakage 2-39

PCA (Printed Circuit Assembly)
Battery 4-80, 5-8, 5-21, 6-4
Power 4-86, 5-8, 5-21, 6-3
SpO2 4-58, 5-8, 6-4
See also Control PCA
See also Interface PCA
PCI (Patient Contact Impedance) 2-32
Peak to Peak reading 2-30
Performance Verification
Configuration Mode 2-10
Diagnostic Mode 2-11
Diagnostic tests 2-19
equipment 2-8
functional checks 2-16
mandatory testing 2-2
safety tests 2-39
Test Matrix 2-4
Visual Inspection 2-4, 2-15
Power Module
defibrillator test 2-6, 2-35
discharging capacitors 4-24
Indicator Matrix 3-29
operational problems 3-29
repair philosophy 1-3
replacement parts 5-20, 5-24
Power modules
electromagnetic compatibility 7-19
Power PCA 6-3
removal and replacement 4-86, 5-8, 5-21
Precautions 7-16
electromagnetic compatibility 7-19
Preventive maintenance 1-2
Primary Label 4-98
Printer 6-4
cable 4-62
Check Printer 3-14
control keys 2-25
ECG functions 2-17
Event Summary 7-6
Extended Self Test 2-22
mandatory testing 2-3
operational problems 3-25
paper 5-18
removal and replacement 5-8
specifications 7-5
System Log 2-20
testing 2-27

Q

QRS beeper 3-20

R

Radio frequency (RF) interference 7-19
RAM test 2-23
Reassembly 4-2
Repair philosophy 1-3
Replacement
connectors 5-12
electrical assemblies 5-7
Key Components 5-2, 5-21
M3500B Unit Exchange Program 5-5
mechanical assemblies and parts 5-10
ordering 5-1
special tools 5-4
subassembly 1-3
supplies and accessories 5-1, 5-18
tables 5-6
RF interference 7-19
ROM test 2-23

S

Safety
tests 2-7, 2-39
Sealed Lead Acid (SLA) battery
See Battery
Selected lead 2-30
Semi-Automatic External Defibrillation (AED) Mode 1-1, 3-21, 7-3
Sensor, SpO2 5-19

Servicing
cable/assembly placement 4-2
flex/internal connections 4-2
instrument reassembly 4-2
Key Components 4-1
telephone assistance 3-31, 5-3
Shock Advisory
functional check 2-17
Softkey
numbering 2-11
operational problems 3-28
testing 2-25
Software Support Tool 2-12
Speaker assembly 4-64, 5-8
labels 5-17
SpO2 monitor 6-8
connector 4-62, 5-12
functional check 2-18
operational problems 3-20
sensors 5-19
specifications 7-6
SpO2 Cable Off 3-13
SpO2 Light Interf 3-13
SpO2 Low/Noisy Signal 3-13
SpO2 Sensor Fail 3-13
SpO2 PCA 6-4
replacement 4-58, 5-8
test 2-24
Status message 2-30
Stop Pacer 3-15
Subassembly replacement 1-3
Supplies 5-1, 5-18
Symbol definitions 7-14
Synchronized
Cardioversion
functional checks 2-18
operational problems 3-21
Synchronizer 7-2
System
error codes 3-4, 3-5, 3-10
interconnections 6-5
messages 3-12
signal and data flow 6-6
System Log 2-20
test 2-23
System Failure
Cycle Power 3-13
Service Unit 3-13

T

T10 (M3X6) screw 5-13
T15 (M4X10) screw 5-13
Telephone assistance
replacement parts 5-1
Response Centers 5-3
service 3-31, 5-3
supplies and accessories 5-1
Test load 5-20
Test Matrix 2-4
Testing
See Performance Verification
Timebase test 2-23
Tool requirements 4-3, 5-4
Top case assembly 4-75, 4-97, 5-12
Trace, ECG 3-18
Training required 7-16
Troubleshooting
audio tones 3-16, 3-27
battery and power modules 3-29
Data Card 3-30
defibrillation/synchronized cardioversion 3-21
display 3-26
ECG monitoring 3-18
error codes 3-4, 3-5, 3-10
Extended Self Test failures 3-17
external failures 3-4
initial assessment 3-3
internal failures 3-5
keys 3-28
methodology 3-2
momentary messages 3-14
pacing 3-24
printer 3-25
repair philosophy 3-1
SpO2 monitoring 3-20
system messages 3-12
tables 3-6
telephone assistance 3-31, 5-3
unresponsive unit 3-8

U

Unit Exchange Program 5-5
Upgrade 1-2

User Interface Test 2-4
Audio Test 2-26
Controls 2-25
Display Test 2-26
Printer Test 2-27
User maintenance 1-2

V

Visual Inspection 2-4, 2-15

W

Waveform
150J 7-8
200J 7-11